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ON THE PSYCHOLOGY OF VOLITION

Linking Action versus State Orientation to Cognitive Control Processes and to Their Neural Architecture

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On the Psychology of Volition: Linking Action versus State Orientation to Cognitive Control Processes and to Their Neural Architecture

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CHAPTER 1

General Introduction

“In art intentions are not sufficient and, as we say in Spanish, love must be proved by deeds and not by reasons. What one does is what counts and not what one had the intention of doing.”

- Pablo Picasso

As Picasso stated in the above quote, having intentions alone does not suffice to make great art or to love deeply. And not only in art and love, but in any area of life, being able to turn intentions into actions is crucial to succeed. An intention never followed by an action does not bring someone closer to her or his goals. As true as this may be, in reality, people often fail to act upon their goals. For example, keeping a diet, giving up smoking, or regularly practicing a new language, often turns out to be more difficult than anticipated, especially when obstacles or complications occur.

How difficult it is to turn intentions into actions, partly depends on the person and partly depends on the situation. Where some people generally have no problems enacting their intentions, others find this more difficult, especially in demanding situations. In the current dissertation, we try to unravel the psychological processes and circumstances that widen or narrow the gap between intentions and action. What are the critical factors that make it easier for some people than for others to turn their intentions into actions in demanding situations? And are there any structural neurological differences related to individual differences in the enactment of intentions? In this brief introductory chapter, we first introduce action control theory, a framework for understanding individual differences in the ability enact intentions. After this, we explain how we address the above questions in the remainder of this dissertation.

Action Control Theory

In action control theory, Kuhl (1985) proposes that there are different volitional modes. The meta-static mode is characterized by high volitional effectiveness, and the ability to flexibly regulate the enactment of context-adequate intentions. This mode is called 'action orientation'. By contrast, in the cata-static mode of control, flexible and context-sensitive enactment of intentions is inhibited. This mode is called 'state orientation'. People may vary in action versus state orientation as a function of situational characteristics and more stable individual differences. To date, however, most attention has been given to individual differences in action versus state orientation.

Beyond the global distinction between action versus state orientation, action control theory also distinguishes between different facets of action versus state orientation. The most well-established distinction to date is that between demand-related action versus state orientation (hesitation versus initiative) and threat-related action versus state orientation (preoccupation versus disengagement). Demand-related action orientation is the most important predictor of people's ability to enact intentions under demanding conditions: conditions that involve difficulties, effort, cognitive load, time pressure, and so on (e.g., Jostmann & Koole, 2006, 2007). When people are action-oriented, demanding circumstances may lead to improved enactment of intentions. When people are state-oriented, demanding circumstances may lead to impaired enactment of intentions. Threat-related action orientation is the most important predictor of enactment of intentions under threatening conditions: conditions that involve failure, anxiety, unexpected events, and so on (e.g. Baumann & Kuhl, 2002, 2003). When people are action-oriented, threatening circumstances may lead to improved enactment of intentions. When people are state-oriented, threatening circumstances may lead to impaired enactment of intentions.

Overview of the Current Dissertation

The remainder of this dissertation consists of five chapters. Each chapter can be read independently from the other chapters. Because each chapter was written as a paper on its own and because the chapters are partly based on the same underlying theory, they inevitably contain some substantive overlap. Notably, the raw data and analyses that form the basis of Chapter 3 have been made publically available in the Journal of Open Psychology Data (Ruigendijk & Koole, 2016). Raw data and analyses from the other chapters will be made available after they have been accepted for publication in a peer-reviewed scientific journal.

Chapter 2 entails a theoretical discussion of the deeper reasons underlying the differences in goal-enactment related to demand-related action versus state orientation. We pit two different and contradicting explanations against each other for these differences. According to the goal neglect hypothesis (Kane & Engle, 2003), state-oriented people are more prone to lose sight of their goals under demanding circumstances because their goal focus is not strong enough (Jostmann & Koole, 2007). Conversely, the over-maintenance hypothesis holds that state-oriented people focus on their goals too strongly and in a narrow linguistic format that prevents flexible action control (Chapter 3, current dissertation). Chapter 2 considers the evidence for these competing hypotheses as explanations for why people high on demand-related state orientation often fail to enact their intentions.

Chapter 3 empirically tests the over-maintenance hypothesis versus the goal neglect hypothesis. Over-maintenance versus goal neglect among state-oriented individuals have so far been examined in separate lines of research (for reviews, see Jostmann & Koole, 2007; Koole, Jostmann, & Baumann, 2012; Kuhl & Beckmann, 1994). Therefore, in Chapter 3 we test the validity of the two competing hypotheses in two different studies. In both studies, participants were categorized as either action- or state-oriented based on the ACS-90 (Action Control Scale -90; Kuhl, 1994) and we manipulated the degree to which participants were focused on their task goal. In both studies, participants performed different cognitive tasks that require initiative and self-directed control. The over-maintenance hypothesis predicts that state-oriented people would perform the difficult actions that are required for the task less efficiently when focusing more strongly on the task goal. By contrast, the goal neglect hypothesis predicts that state-oriented people would perform the difficult actions less efficiently when focusing less strongly on the task goal. Both hypotheses predict no such pattern for action-oriented people. Indeed, action-oriented people often display the reverse pattern of state-oriented people (see Koole et al., 2012).

Chapter 4 investigates whether state-oriented individuals are more prone to rely on reactive control processes for the enactment of intentions than action-oriented individuals. To detect these reactive control processes we measured congruency sequence effects in two different studies. Congruency sequence effects are a result of reactive control processes that occur when increased control during one trial (e.g. in response to an incongruent trial in the Stroop task) transfers to the next trial (e.g. a next incongruent trial in the Stroop task; Botvinick, Braver, Barch, Carter, & Cohen, 2001). In both studies, we categorized participants as either action- or state-oriented based on their individual scores on the ACS-90 (Kuhl, 1994) and we manipulated the degree to which participants were focused on their task goal. We expected that state-oriented participants would display significant congruency sequence effects when they were weakly (rather than strongly) focused on the task goal (Studies 3.1 and

3.2) and especially when helpful pre-cues were available (Study 3.2). If by contrast, action-oriented participants would display no evidence of congruency sequence effects, our hypothesis that state-oriented people are more prone to rely on reactive control than action-oriented people would be supported.

Chapter 5 explores whether individual differences in action versus state orientation are reflected in the structure of the brain. Not many studies have investigated the neural underpinnings of action versus state orientation. In one of the few studies that focused on neural correlates, functional differences between action- and state oriented individuals have been found during the processing of emotional stimuli (Rosahl, Tennigkeit, Kuhl, & Haschke, 1993). These functional correlates reveal transient differences in brain activity. However, because action orientation is a relatively stable trait-like construct, we expected that differences between action- and state-oriented individuals would also be visible in the structure of the brain. Therefore, in chapter five, we explored whether individual differences in action versus state orientation were related to the density and direction of the white matter tracts and the concentration of gray matter in the brain.

Gray matter is mainly composed of the neural cell bodies, unmyelinated axons and other cells that process and structure cognitive information. Therefore differences in gray matter between action- and state-oriented people indicate differences in cognitive processing that are more long-lasting than the transient influence of the environment or a temporary state of mind. White matter is mainly composed of myelinated axon bundles and is the connective tissue that allows information to travel between the different gray matter areas. Therefore, differences in white matter between action- and state oriented people indicate structural differences in communication between different brain areas.

Demand-related and threat-related action orientation are conceptually distinct (Kuhl & Beckmann, 1994). However, previous work has yielded somewhat conflicting findings regarding the separability of demand-related and threat-related action orientation (e.g. Diefendorff, Hall, Lord, & Strean, 2000; Kuhl, 1994; Papantoniou, Moraitou, Dinou, & Katsadima, 2010; Blunt & Pychyl, 1998; Frese, Fay, Hilburger, Leng, & Tag, 1997; Rholes, Michas, & Shroff, 1989). Therefore, an important goal of the current study was to explore whether decisiveness and disengagement have separate correlates in the brain. Distinguishable structural neural correlates that relate to each facet of action orientation would support earlier findings that decisiveness and disengagement are indeed separate psychometric dimensions.

Chapter 6 summarizes the methodology and the main findings of the three empirical chapters. Furthermore, the theoretical implications of the studies in the current dissertation and suggestions for directions for future research will be discussed. The chapter ends with the practical implications of the current research.

CHAPTER 2

Why the Road to Hell is Paved With Good Intentions: Paradoxical Effects of Volitional Action Control

"Maar tussen droom en daad staan wetten in de weg, en praktische bezwaren en ook weemoedigheid, die niemand kan verklaren, en die des avonds komt, wanneer men slapen gaat".
["But between dream and deed laws get in the way, and practical objections, and also melancholy, that no one can explain, and which comes in the evening, when one goes to sleep".]

- Willem Elsschot, Het Huwelijk [The Marriage], May 7, 1910

| Why the Road to Hell is Paved With Good Intentions: Paradoxical Effects of Volitional Action Control[1]

The above lines by Dutch poet Willem Elsschot refer to the unbridgeable gap that often looms between people's wishes and reality. Most people would like to adopt healthier habits, have more satisfying relationships, and be more productive at work. However, people regularly fail to act upon these ambitions. Part of the problem may be lack of time or ability, which Elsschot referred to as "laws and practical complaints". However, most people are quite capable of eating less and exercising more, acting nicer to their partner, and working harder than they do. What is it, then, that keeps

1 This Chapter is based on: Ruigendijk, H.A.H., Jostmann, N.B., & Koole, S.L. (2018). Why the road to hell is paved with good intentions: Paradoxical effects of volitional action control. In N. Baumann, M. Kazén, M.R. Quirin, & S.L. Koole (Eds.) *Why people do the things they do* (pp. 151-167). Göttingen, Germany: Hogrefe.

people from doing the right thing? Is it Elsschot's "melancholy that no one can explain"? Or can we gain a deeper scientific understanding of why people frequently fail to meet their goals?

Both common sense and established psychological theories suggest that people may not achieve their goals when they lose sight of them. The take home message – which is pervasive in self-help books- seems to be that people should stop complaining and focus more on their goals. We agree that sidetracking exists and that increasing one's goal focus can promote goal achievement. At the same time, however, we question whether increasing goal focus will be universally helpful. People who are struggling to enact their goals may well think more about these goals than the people who quickly put their goals into action. Thus, it seems doubtful whether increasing goal focus will do much good. Indeed, we suggest that increased goal focus may backfire among people who often fail to enact their goals, causing this group to act *less* upon their goals. If this view is valid, then many people may paradoxically achieve their goals more often when they adopt a more easygoing attitude towards goal achievement.

In what follows, we begin by introducing the literature on individual differences in goal enactment, which has highlighted the notion of action versus state orientation. Goal enactment tends to be high among so-called action-oriented people, whereas so-called state-oriented people tend to have low goal enactment. Next, we consider the deeper theoretical reasons why action- versus state-oriented people might differ in their rates of goal enactment. We first discuss the goal neglect hypothesis (Jostmann & Koole, 2007), which holds that action control deficits among state-oriented people are due to insufficient goal focus. Next, we advance the *over-maintenance hypothesis* (Ruigendijk & Koole, 2014), which states that state-oriented people are prone to think about their intentions in a narrow linguistic format that prevents flexible action control. We then discuss recent research that conducted a competitive test of the goal neglect and over-maintenance hypotheses. Finally, at the end of this chapter, we summarize our main conclusions and consider the broader implications of this work.

Individual Differences in Action versus State Orientation

Individual differences in goal enactment have received much theoretical and empirical attention in the context of action control theory (Kuhl, 1983, 1984, 1994a, 2000). According to action control theory, people need to call upon superordinate action control processes when their goals are difficult to enact, for instance, when it requires a complex sequence of steps or long hours of hard work. These superordinate forms of

action control are theoretically related to the lay notion of willpower or volition, and scientific notions such as self-regulation (Baumeister & Vohs, 2016), cognitive control (Botvinick, Braver, Barch, Carter, & Cohen, 2001), or executive function (Hofmann, Schmeichel, & Baddeley, 2012).

Action control theory (Kuhl, 1983, 1984, 1994a, 2000) further proposes that action control processes are attuned to the social environment, such that different socialization experiences may facilitate or inhibit action control. When socialization experiences support mastery experiences and personal autonomy, action control processes become facilitated in the person. Action control theory refers to this disposition as "action orientation". By contrast, when socialization experiences are overly controlling or negligent, action control processes become inhibited in the person. Action control theory refers to this disposition as "state orientation". Action versus state orientation may vary both situationally and chronically. Thus, when patterns of socialization experiences are repeated over time, people may acquire a chronic disposition towards action versus state orientation (for the parental role in the development of action control see also Hirschauer, Aufhammer, Bode, Chasiotis, & Künne, 2018; Liesenfeld, 2018).

Kuhl (1994b) developed the action control scale, a self-report instrument to assess individual differences in action versus state orientation. The action control scale has several subscales, which reflect different facets of action versus state orientation. In the present context, the demand-related scale is most relevant. For the sake of brevity, we refer to this scale simply as 'action versus state orientation'. Illustrative items are displayed in Table 2.1. The scale consists of 12 items that describe situations in which initiation of a goal-related action is pending. For each situation, participants have to choose their most likely response from two alternatives.

Typically, action-oriented choices on the action control scale are summed to create a single index. The resulting scores represent a continuum that ranges from state orientation to action orientation. Originally, researchers tended to categorize participants as being either action- or state-oriented, using the median or conceptual midpoint of the scale. In recent years, scores on the action control scale have more often been analyzed as a continuous variable. Typically, the categorical and continuous scoring methods yield similar results. For convenience, we still use the term 'action-oriented people' for those scoring relatively high on the action control scale, and the term 'state-oriented people' for those scoring relatively low on the action control scale. Psychometric analyses of the action control scale have confirmed that the scale has satisfactory measurement properties (Diefendorff, Hall, Lord, Strean, 2000; Kuhl, 1994b; Papantoniou, Moraitou, Dinou, & Katsadima, 2010).

Individual differences in action versus state orientation are moderately correlated with other individual difference variables. For example, action versus state orientation correlated significantly with dependability (r = .38), emotional stability (r = .22), and with extraversion (r = .15), (Diefendorff et al., 2000). However, action versus state orientation is not redundant with these variables. Table 2.2 lists studies demonstrating that action versus state orientation is empirically separable from 24 individual-difference variables. These include classic personality variables such as extraversion and neuroticism, motivational variables such as achievement motivation, cognitive variables such as self-consciousness and working memory capacity, and volitional variables such as personal initiative. Although this overview is not exhaustive, it suggests that the action control scale captures unique behavioral variance that is not explained by other individual differences.

| Table 2.1

The Demand-Related Action Control Scale (Kuhl, 1994b; Action-Oriented Responses Are Marked with an Asterisk)

1. When I know I must finish something soon:
A. I have to push myself to get started
B. I find it easy to get it done and over with*

2. When I don't have anything in particular to do and I am getting bored:
A. I have trouble getting up enough energy to do anything at all
B. I quickly find something to do*

3. When I am getting ready to tackle a difficult problem
A. It feels like I am facing a big mountain that I don't think I can climb
B. I look for a way that the problem can be approached in a suitable manner*

4. When I have to solve a difficult problem:
A. I usually don't have a problem getting started on it*
B. I have trouble sorting out things in my head so that I can get down to working on the problem

5. When I have to make up my mind about what I am going to do when I get some unexpected free time:
A. It takes me a long time to decide what I should do during this free time
B. I can usually decide on something to do without having to think it over very much*

6. When I have work to do at home:
A. It is often hard for me to get the work done
B. I usually get it done right away*

7. When I have a lot of important things to do and they must all be done soon:
A. I often don't know where to begin
B. I find it easy to make a plan and stick with it*

8. When there are two things that I really want to do, but I can't do both of them:
A. I quickly begin one thing and forget about the other thing I couldn't do*
B. It's not easy for me to put the thing that I couldn't do out of my mind

9. When I have to take care of something important but which is also unpleasant
A. I do it and get it over with*
B. It can take a while before I can bring myself to do it

10. When I am facing a project that has to be done:
A. I often spend too long thinking about where I should begin
B. I don't have any problem getting started*

11. When I have a boring assignment:
A. I usually don't have any problem getting through it*
B. I sometimes just can't get moving on it

12. When I have an obligation to do something that is boring and uninteresting:
A. I do it get it over with*
B. It usually takes a while before I get around doing it

Action-State Orientation and Goal Enactment

According to action control theory (Kuhl, 1983, 1984, 1994a, 2000), individual differences in action versus state orientation should moderate goal enactment. This prediction was first examined in a field study in which German school children (N = 48) rated their intentions to perform a list of 22 after-school activities (Kuhl, 1982). The day afterwards, the children reported how much time they had actually spent performing each activity. As expected, intention-behavior correlations among action-oriented children were significantly higher than those among state-oriented children. Similar effects of action-state orientation have been found for intention-behavior relations among adults in other life domains, including weight loss (Schifter & Ajzen, 1985), dieting (Fuhrman & Kuhl, 1998), exercise behavior (Friederichs, Kremers, Lechner, & de Vries, 2013; Kendzierski, 1990), and job search behavior (Song, Wanberg, Niu, & Xie, 2006).

Additional field studies have examined the relation between action-state orientation and performance. In this type of research, all participants can be assumed to have the goal of performing well. Diefendorff et al. (2000) found that action-oriented workers displayed higher levels of job performance – as rated by supervisors - than state-oriented workers. Notably, action-state orientation explained four to five times more variance in supervisor ratings than a conventional personality measure, which assessed individual differences in extraversion, agreeableness, conscientiousness, emotional stability, and intellect (the "big five"; Goldberg, 1992). These basic findings have been replicated in various subsequent studies (Baumann & Scheffer, 2011; Diefendorff, Richard, & Gosserand, 2006; Jaramillo, Locander, Spector, & Harris, 2007; for an overview see also Diefendorff, Richard, Dinh, & LeNoble, 2018). Likewise, action orientation has been linked to better education performance (Boekaerts & Otten, 1993; Diefendorff, 2004; Jaramillo & Spector, 2004). Finally, action orientation has been associated with better health behaviors, such as maintaining a healthy diet (Fuhrman & Kuhl, 1998), less overeating (Palfai, 2002), and less binge drinking (Palfai, McNally, & Roy, 2002).

According to action control theory, action orientation should only facilitate actions that are difficult to execute and therefore require the involvement of superordinate control processes. Circumstances that make action execution more difficult should therefore moderate the relation between action-state orientation and goal enactment. This prediction has been considered in a field study by Diefendorff et al. (2006), who observed that action orientation only predicted better work performance among employees who rated their jobs as low in routineness, low in satisfaction, and not involving. Related findings were obtained by Heckhausen and Strang (1988) who asked a group of semi-professional male basketball players to play a standardized

basketball track. Under normal conditions, there were no performance differences between high- and low-decisive players. However, when players were challenged to break their personal record, low-decisive players showed significant deteriorations in performance (e.g., lower hit rates, more dribbling errors). The moderating role of task difficulty may help to explain why some field studies observed no relation between action-state orientation and intention-behavior relations (Norman, Sheeran, & Orbell, 2003) or task performance (Häger, Schlapkohl, & Raab, 2014).

| Table 2.2

Separability of Action-State Orientation and Other Individual Difference Constructs

Construct (Reference to Empirical Measure between Brackets)	Reference
Achievement Motivation, Explicit (Elliot & McGregor, 2001)	Jostmann & Koole (2007)
Achievement Motivation, Implicit (McClelland, Koestner, & Weinberger, 1989)	Heckhausen & Strang (1988)
Attention Control (Kane et al., 1994)	Diefendorff et al. (1998)
Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Intellect (Goldberg, 1992)	Diefendorff et al. (2000)
Goal Orientation (Dweck, 1986)	Diefendorff (2004)
Impulse Control (Kuhl & Fuhrmann, 1998)	Baumann & Kuhl (2005)
Independent Personality Style (Kuhl & Kazén, 1997)	Baumann, Kaschel, & Kuhl (2007)
Intelligence (Wechsler, 1981)	Diefendorff et al. (1998)
Intrinsic Motivation (Oliver & Anderson, 1994)	Jaramillo, Locander, Specter, & Harris (2007)
Locus of Control (Rotter, 1966)	Bagozzi & Baumgartner (1992)
Optimism (Scheier & Carver, 1985)	Bossong (2001)
Personal Initiative (Frese et al., 1997)	Jaramillo et al. (2007)
Preoccupation (Kuhl, 1994b)	Koole (2004)
Proactive Personality (Crant, 2000)	Diefendorff et al. (2006)
Reappraisal and Suppression Tendencies (Gross & John, 2003)	Koole & Jostmann (2004)
Self-Consciousness (Fenigstein, Scheier, & Buss, 1975)	Diefendorff et al. (2000)
Self-Efficacy (Bandura, 1991)	Diefendorff (2004)
Self-Esteem (Rosenberg, 1965)	Koole & Jostmann (2004)
Working Memory Capacity (Turner & Engle, 1989)	Jostmann & Koole (2006)

The aforementioned field studies have the advantage of being relevant for everyday life. However, field settings do not afford much control over the stimuli that participants encounter. Several studies have therefore been conducted under more controlled laboratory conditions, examining the effects of action-state orientation on standardized performance measures, such as working memory (Jostmann & Koole, 2006, Study 2), Stroop color naming interference (Jostmann & Koole, 2007), visual search (Dibbelt, 1997; Kazén, Kaschel & Kuhl, 2008, Study 2), tower of Hanoi (Jostmann & Gieselmann, 2014), and a sensori-motor task (Gröpel, Baumeister, & Beckmann, 2014; Gröpel & Beckmann, 2018). Overall, these studies have confirmed that action-oriented people display better task performance than state-oriented people. However, this performance advantage only emerges under conditions that make task execution demanding, such as after visualizing a demanding person (Jostmann & Koole, 2006), having to self-initiate actions (Kazén et al., 2008; Kaschel & Kazén, 2018), or after performing a strenuous task (Gröpel et al., 2014). When task conditions are supportive, action-oriented people lose their edge, and may even be outperformed by state-oriented people (Jostmann & Koole, 2006).

In sum, there is converging evidence from field studies and laboratory research that goal enactment is moderated by individual differences in action versus state orientation (see also Koole, Jostmann, & Baumann, 2012). Action-oriented people tend to show higher rates of goal enactment than state-oriented people. This difference is most pronounced when the task is difficult and the situation demanding. When the task is easy and the situation is supportive, the performance of state-oriented people is similar to or even better than that of action-oriented people. The moderating role of situational and task demands is theoretically important, because it rules out general differences in motivation or cognitive capacity as an explanation for the effects of action versus state orientation.

The Goal Neglect Hypothesis

Why do action- versus state-oriented people differ in their rates of goal enactment? Perhaps the most straightforward possibility is that state-oriented people are less capable of focusing on their goals than action-oriented people. Research has shown that focusing on a goal tends to improve performance (Locke & Latham, 1990). Thus, we may suspect that state-oriented people have problems staying focused, leading them to neglect their task goal. We refer to this as the *goal neglect* hypothesis (Duncan, Emslie, Williams, Johnson, & Freer, 1996). The goal neglect explanation fits well with the findings that the problems of state-oriented people show up mostly during difficult tasks, because difficult tasks impose greater demands on people's attention

(Petersen & Posner, 2012). Moreover, goal neglect may also explain why demanding conditions make things worse for state-oriented people, because it seems plausible that demanding conditions may distract their attention away from their focal goal.

The goal neglect account seemed to us like a potentially useful way of understanding why state-oriented people often fail to act upon their goals. We therefore put it to an explicit experimental test (Jostmann & Koole, 2007). In this work, we used the well-established Stroop task to measure task performance. In this task, participants were asked to classify the ink colors of words that were appearing one by one on a computer screen. The meaning of the words was either neutral (a string of X-es), congruent (e.g., the word "blue" appearing in blue ink), or incongruent (e.g., the word "blue" appearing in red ink) with the ink colors. Reading the word meanings has become automatic for literate people. Consequently, people generally find the task harder (as indicated by slower response times and more errors) when the word meanings and ink colors are incongruent rather than congruent. This well-established interference phenomenon is known as the Stroop effect (MacLeod, 1991).

Earlier, Kane and Engle (2003) had devised a clever method for examining goal neglect in the Stroop task. Recall that the Stroop task consists of both congruent trials (in which the word meanings and ink colors are matched) and incongruent trials (in which the word meanings and ink colors are mismatched). Kane and Engle varied the proportion of congruent and incongruent trials, such that one type of trial became much more common than the other. The researchers argued that, if incongruent trials are much more common than congruent trials, then people are constantly cued with the task goal of responding only to the ink colors. By contrast, if congruent trials are much more common than incongruent trials, people might be tempted to start reading the word meanings, because this is easier and mostly yields the correct response. As a result, a high proportion of congruent trials in the Stroop task may set people up for goal neglect.

Using the Kane and Engle (2003) logic, we examined whether action-state orientation was more predictive of Stroop performance when congruent trials were common (75% of all trials) or less common (12.5% of all trials). We also manipulated prospective working memory load during the task, to make sure that the setting was sufficiently demanding. The results were clear: action-state orientation was only predictive of Stroop performance when working memory load was high and congruent trials were common. Thus, state-oriented people displayed performance deficits in the Stroop task exactly under the conditions that according to Kane and Engle would encourage goal neglect. On the basis of these findings, along with the rest of the literature, we concluded that goal neglect was likely to be a key mechanism in explaining action control problems among state-oriented people (Jostmann & Koole, 2007). However, as we discuss in the next section, the case on this matter was far from closed.

The Over-maintenance Hypothesis

An underlying assumption of the goal neglect hypothesis is that the cognitive maintenance of a goal is directly coupled with the enactment of the goal. In other words, just thinking about a goal will already propel the person towards action. The validity of this assumption has been challenged by action control theorists. More specifically, Kuhl (2000) has suggested that thinking about a goal is quite a different thing from acting upon it. In more theoretical terms, Kuhl has proposed a functional dissociation between the cognitive systems that keep goals activated in working memory and the behavioral systems that support the enactment of goals.

The starting point for Kuhl's (2000) theory is the notion that goals – as explicit, linguistically verbalizable representations of intended actions – are not responsible for the on-line, moment-to-moment control of people's overt behavior. Instead, people's behavior is guided by implicit programs that flexibly and automatically adjust themselves to the specifics of the situation. When difficulties arise, however, the automatic stream of behavior becomes interrupted and people start to deliberate about what to do next. The final products of such conscious problem solving efforts are linguistic representations of intended actions – what we call 'goals'. This goal formation process is a precarious affair, because the goal must be kept cognitively accessible while, at the same time, its behavioral enactment must be delayed to avoid premature action. The cognitive maintenance of a goal is therefore accompanied by inhibition of automatic behavior, or *volitional inhibition* (Kuhl & Kazén, 1999).

As long as volitional inhibition is in place, the goal cannot be enacted in a flexible and context-sensitive manner. Flexible action control thus requires a mechanism for releasing volitional inhibition. According to Kuhl's theory, this release mechanism is a brief increase in positive affect, which serves as an internal signal that the goal can be transferred to automatic behavioral programs that put it into action (Kuhl & Kazén, 1999). At this point, individual differences in action versus state orientation come into play. Action-oriented people are presumably capable of quickly up-regulating positive affect (Koole & Jostmann, 2004), so that they can easily release volitional inhibition once the time for action has come. By contrast, state-oriented people are not as effective in cheering themselves up, which means that they can get stuck in the state of volitional inhibition once they have begun to think about their goal. In this state, goals are maintained in a narrow linguistic format while implicit knowledge structures that are needed for context-sensitive action are inhibited. The problems of state-oriented people with enacting their goals may be attributed to this dissociated state. We refer to this as the *over-maintenance hypothesis*.

Preliminary evidence for the over-maintenance hypothesis was found by Goschke and Kuhl (1993; see also Goschke & Kuhl, 1996). In their intention memory paradigm, participants have to memorize scripts of simple activities (e.g., clearing a desk or sorting mail), and some of the scripts have to be enacted by the participant later on. In three out of four experiments, state-oriented people displayed better memory for the to-be-enacted scripts than action-oriented people (Goschke & Kuhl, 1993; see also Goschke & Bolte, 2018). Moreover, in the only experiment where action- and state-oriented people displayed equally good memory for the to-be-enacted scripts, the enactment directly followed after the memory test. State-oriented people were thus much more inclined than action-oriented people to mentally rehearse their goals, and even did so when the goal was to be executed much later in time. These findings are thus consistent with the over-maintenance hypothesis.

Other studies have shown that action-oriented people are more prone to experience flow during achievement tasks than state-oriented people (Baumann & Scheffer, 2010). Achievement flow is a motivational state in which people are completely absorbed in an activity, displaying high concentration without effort, and a merging of thought and action (Csikszentmihaly, 1990). Because flow is characterized by an absence of conscious thoughts about one's goals, the state of flow represents the psychological antithesis of volitional inhibition. Presumably, the propensity towards volitional inhibition lowers the receptiveness of state-oriented people for flow experiences. As such, the over-maintenance hypothesis is consistent with a lower prevalence of flow experiences among state-oriented people.

At first glance, the over-maintenance hypothesis seems inconsistent with the evidence presented by Jostmann and Koole (2007, Study 3), which seemed to suggest that state-oriented people were prone to goal neglect in a Stroop paradigm. However, there is a critical ambiguity in the latter findings. Recall that Jostmann and Koole manipulated the proportion of congruent trials in the Stroop task, such that the goal of color naming was continuously cued (in a condition with mostly incongruent trials) or not cued (in a condition with mostly congruent trials). In this paradigm, lower performance in the absence of cuing could signify goal neglect. However, when people get fewer task cues, they also have to be more proactive during the task (Braver, Gray & Burgess 2007). This point was already noted by Jostmann & Koole (2007), who noted that "Goal neglect should thus not be equated with simply forgetting the task intention. Instead, goal neglect can be regarded as difficulty in initiating cognitive control" (p. 594). Prior work has shown that proactive control is impaired by over-maintenance processes (Baumann, Kaschel & Kuhl, 2005; Kazén et al. 2008). It is hence possible that the pattern among state-oriented people in Jostmann and Koole's research was caused by over-maintenance.

Over-maintenance versus Goal Neglect

The over-maintenance and goal neglect hypotheses each form a viable theoretical explanation for the problems with goal enactment that have been observed among state-oriented people. This would be no problem if the two mechanisms could operate side by side. In fact, however, the mechanisms are mutually contradictory. If state-oriented people are prone to goal neglect, this implies that they think too little about their goals. By contrast, if state-oriented people are prone to over-maintenance, this implies that state-oriented people think too much about their goals. This contradiction is not merely academic, because the two mechanisms have opposite implications for helping state-oriented people to overcome their volitional problems. If goal neglect drives these problems, practitioners should help state-oriented people to focus *more* on their goals. If over-maintenance is the culprit, practitioners should help state-oriented people to focus *less* on their goals.

To establish whether state-oriented people are prone to either goal neglect or over-maintenance, it is necessary to design studies in which both mechanism are pitted against each other. Ruigendijk and Koole (2014) recently conducted two such studies. These researchers examined the effects of action versus state orientation in a Stroop task (MacLeod, 1991) and a task switching paradigm (Dreisbach & Goschke, 2004), two well-established methods for assessing action control processes. Similar paradigms had been used before in previous research on action-state orientation (e.g., Jostmann & Koole, 2007). However, Ruigendijk and Koole introduced a critical addition, by experimentally manipulating the extent to which participants were focused on their goals. In the strong goal focus condition, participants were told that the best strategy for performing the task was to be as active as possible, to focus on the task instructions, and to use their conscious attention to give the right response. By contrast, in the weak goal focus condition participants were told that the best strategy was to relax, to trust their feelings and let the right answer come to them. Participants in both groups were told to try to respond as quickly and as accurately as possible.

The goal neglect and over-maintenance hypotheses make opposite predictions regarding the effects of goal focus. If state-oriented people are prone to goal neglect, we should expect them to show better action control when the task instructions force them to focus strongly (rather than weakly) on their task goal. By contrast, if state-oriented people are prone to over-maintenance, we should expect to show better action control when the task instructions force them to focus weakly (rather than strongly) on their task goal. In a first study, Ruigendijk and Koole (2014) examined this prediction in a Stroop task. As in Jostmann and Koole (2007, Study 3), the task contained a high proportion of congruent trials, because this version of the task was previous argued to be most conducive to goal neglect (Kane & Engle, 2003).

The results showed that action-oriented participants showed low levels of Stroop interference regardless of their goal focus. However, goal focus did have a significant effect among state-oriented participants, who displayed lower Stroop interference in the weak goal focus condition than in the strong goal focus condition. The latter pattern corresponds to the predictions of the over-maintenance hypothesis.

In a follow-up study, Ruigendijk and Koole (2014, Study 2) conducted a more refined test of the kind of over-maintenance that state-oriented people are prone to. We suggest that over-maintenance processes lead state-oriented people to encode goal-related stimuli more strongly in linguistic terms. If this is correct, then state-oriented people can be expected to display lower distractibility by goal-irrelevant information, a process known as "goal shielding". Because goal shielding is automatic, it applies only to relatively effortless tasks that can be delegated to automatic linguistic encoding processes. This explains why Ruigendijk and Koole did not find it in the Stroop task in their first study. In their second study, however, Ruigendijk and Koole used a task switching paradigm which could test the presumed goal shielding mechanism.

Specifically, Ruigendijk and Koole (2014, Study 2) again manipulated goal focus as in their first study, but this time examined a task-switching paradigm (Dreisbach & Goschke, 2004) instead of a Stroop task. In the first stage of the paradigm, participants had to perform a relatively simple categorization task. It was predicted that, due to their over-maintenance tendencies, state-oriented participants would show lower distractibility by task-irrelevant information than action-oriented participants in this stage, especially when they would be strongly (rather than weakly) focused on their task goal. This prediction was confirmed by our results. In the second stage of the paradigm, the task goal was changed, such that what were formerly the distracters became the targets for participants and vice versa. This kind of switch requires participants to mentally disengage from their old task goal in order to adhere to their new task goal. We expected that over-maintenance would make this mental disengagement harder. Therefore, we expected state-oriented participants to show more perseveration of their (now irrelevant) old task goal than action-oriented participants, again, especially when they would be strongly (rather than weakly) focused on their task goal. This second prediction was also confirmed.

The findings by Ruigendijk and Koole's (2014) second study provide the most direct evidence to date of the over-maintenance hypothesis, by showing within a single paradigm how state-oriented people may be more focused on their task goal (i.e., less distractible), but simultaneously less flexible in enacting their task goals (see also Goschke & Bolte, 2018). Together with Ruigendijk and Koole's (2014) first study, these findings support the over-maintenance hypothesis: State-oriented participants show better (especially more flexible) action control in the weak goal focus condition than in the strong goal focus condition. Thus, a competitive test of the two mechanisms

indicates that state-oriented people are prone to over-maintenance, not goal neglect. In each of the two studies of Ruigendijk and Koole (2014) separately, action-oriented participants were not significantly affected by the goal focus manipulation. However, when the results were combined across both studies, action-oriented participants were found to show the opposite pattern as state-oriented participants: Action-oriented participants displayed better action control in the strong goal focus condition than in the weak goal focus condition. The latter pattern was not the main interest of the studies. However, it is consistent with the idea that action-oriented people are capable of consciously turning the mobilization of action control processes on and off. When action-oriented people want to focus on the task at hand, their action control resources are mobilized. When action-oriented people want to relax, their action control resources are switched off. For action-oriented people, then, increasing their goal focus does facilitate action control. It may be for this reason that goal focus has become such a popular recipe for success in the self-help literature.

Going back to state-oriented people, one somewhat puzzling aspect of Ruigendijk and Koole's (2014) findings is how relaxing their focus from the task goal helped them to improve their action control. We clarified this issue in two follow-up studies (Ruigendijk & Koole, 2016). The latter studies examined trial-to-trial variations in action control. If people encounter a response conflict during one trial, this tends to facilitate action control during the next trial (Gratton, Coles & Donchin, 1992). Such trial-to-trial conflict adaptation processes have been extensively investigated by cognitive psychologists (for a review, see Duthoo, Abrahamse, Braem, Boehler, & Notebaert, 2014). Especially when the time between trials is short, trial-to-trial conflict adaptation seems to be driven by low-level, reactive control processes. We suspected that state-oriented people rely on such reactive forms of control when they relax their goal focus. Consistent with this, the results of two studies showed that state-oriented participants displayed stronger trial-to-trial conflict adaptation under the weak intention focus than under strong intention focus. Action-oriented participants did not display trial-to-trial conflict adaptation in both studies, which is consistent with our reactive interpretation of this effect.

Conclusions and Outlook

Virtually everyone fails to action upon her or his goals at least once in a while. However, some people are less likely to enact their goals than others. In this chapter, we reviewed how the construct of action versus state orientation captures such individual differences in the rate of goal enactment. Individual differences in action-state orientation can be reliably and validly assessed through self-report, and are

empirically separable from other personality constructs. Field studies have shown that, compared with action-oriented people, state-oriented people display weaker intention-behavior relations, along with attenuated performance in important life domains such as work, education, sports, and health behavior. Controlled laboratory experiments have linked state orientation to poorer working memory and cognitive control, especially in difficult tasks and under demanding conditions.

In the present chapter, we considered two possible explanations why state-oriented people may be less likely to enact their goals than action-oriented people. According to the goal neglect hypothesis, state-oriented people do not focus enough on their goals, which leads them to be sidetracked. By contrast, according to the over-maintenance hypothesis, state-oriented people focus too much on their goals in the abstract, which leads them to neglect the practical implementation of their goals. The literature to date is broadly consistent with both the goal neglect and over-maintenance hypotheses, even though their presumed mechanisms are mutually contradictory. We therefore designed a series of experiments that directly pitted the goal neglect hypothesis against the over-maintenance hypothesis (Ruigendijk & Koole, 2014, 2016). These experiments examined whether increasing goal focus would lead state-oriented people to display better action control (as predicted by the goal neglect hypothesis) or worse action control (as predicted by the over-maintenance hypothesis). The results of these experiments clearly supported the over-maintenance hypothesis. It thus appears that state-oriented people often fail to enact their goals because, paradoxically, they are cognitively preoccupied by their goals.

Does this mean that state-oriented people will never show goal neglect? It would be premature to draw this conclusion. Ruigendijk and Koole (2014) only examined the effects of goal focus and action-state orientation in a laboratory setting, in which participants had only one task goal. Everyday life is, of course, considerably more complex because it requires people to continually switch between different tasks and goals. If state-oriented people become cognitively preoccupied by one goal, they may be more prone to overlook another goal that urgently requires their attention. In fact, the task switching findings by Ruigendijk and Koole (2014, Study 2) suggest that this may occur. Moreover, state-oriented people also tend to show performance drops in lab experiments where they had to first think of one goal and then move on to another goal (e.g., Jostmann & Koole, 2007). The latter performance drops seem most pronounced for tasks that require working memory (Jostmann & Koole, 2006) and may be more prevalent among older (rather than younger) adults (Kaschel, Kazén & Kuhl, 2016). Over-maintenance may thus eventually set state-oriented people up for goal neglect in dynamic environments where multiple goals are calling for their attention.

The findings in this chapter could have important theoretical and practical implications. The prior literature has often been taken to mean that state-oriented people are generally worse off than their action-oriented counterparts. We have repeatedly tried to correct this misconception (e.g., Koole, Kuhl, Jostmann, & Vohs, 2005). The present work may further assist in this process, by highlighting how a simple instruction to relax may reduce a good part of the action control problems of state-oriented people. In more practical terms, the present chapter suggests that state-oriented people might be helped in real-life settings by paradoxical interventions, in which relaxing their goal focus may increase their chances of actually achieving their goals. For state-oriented people, the road to hell indeed appears to be paved with good intentions, but only when these good intentions are too much on their mind.

CHAPTER 3

When Focusing on a Goal Interferes with Action Control: Action Versus State Orientation and Over-Maintenance of Intentions

When Focusing on a Goal Interferes with Action Control: Action Versus State Orientation and Over-Maintenance of Intentions[1]

Within modern Western society, goal-directedness is generally seen as vital to success. Techniques that encourage people to explicate their goals and action plans are widely propagated in management books and motivational training programs, often accompanied by such catchphrases as "people with goals succeed because they know where they're going" and "people only hit what they aim at". However, the effects of goals on achievement may be more complex than is often acknowledged. Merely focusing on one's goals does not guarantee that these goals will be effectively implemented. Indeed, we suggest in this article that some people may paradoxically fail at enacting their goals *because* they are focusing on their goals.

Our conception of goals is derived from an action-theoretical perspective[2] (Koole, Jostmann, & Baumann, 2012; Kuhl, 1984, 1994, 2000). From this perspective, human behavior is governed by a balance between reactive versus proactive control processes. Reactive control relies on established routines or schemas that require little or no conscious supervision (e.g., Braver, Gray, & Burgess, 2007; Custers & Aarts, 2010; Koole & Rothermund, 2011; Lau & Passingham, 2007). At times, however, people need to intervene more proactively in the stream of behavior. Pro-active control is especially needed when people cannot rely on pre-established behavioral routines (Meiran, Cole, & Braver, 2012), when an action must be postponed until a specific opportunity (Braver et al., 2007), or when an action requires a sequence of multiple steps (Zanini, Rumiati, & Shallice, 2002). During proactive control, people often form an explicit linguistic representation that binds the different components of an intended action together. In this article, we refer to the latter type of mental representations as 'goals' or 'intentions'[3].

1. This chapter is based on: Ruigendijk, H. A. H., & Koole, S. L. (2014). When focusing on a goal interferes with action control: action versus state orientation and over-maintenance of intentions. *Motivation and Emotion, 38(5)*, 659-672. doi:10.1007/s11031-014-9415-4
2. Action control theory was originally proposed by Kuhl and associates in the 1980s (Kuhl, 1984). Its presumed cognitive mechanisms of action control were elaborated during the 1990s (Kuhl, 1992, 1994). In the 2000s, the theory was extended into a personality systems interactions (PSI) theory, a comprehensive functional analysis of motivation and personality (Kuhl, 2000). The interplay between intentions and action is a major aspect of PSI theory and is thus fully consistent with the present work. However, PSI theory also makes assumptions about the affective modulation of action control, which are beyond the present scope. In this article, we refer to this family of theories collectively as the 'action-theoretical perspective'.
3. Within the action-theoretical tradition, the term 'goals' often denotes mental representations of desired outcomes, whereas the term 'intentions' often denotes mental representations of to-be-enacted behaviors. Although we agree that this differentiation is theoretically meaningful and useful, we note that, within contemporary psychology, researchers have often used the terms 'goals' and 'intentions' interchangeably (e.g., Austin & Vancouver, 1996). Because the theoretical comparison between goals and intentions is not central to the present research, we followed the general convention in treating the two constructs as more or less interchangeable.

After forming an intention, people need to maintain the intention in working memory (Braver et al., 2007; Goschke & Kuhl, 1993). This maintenance process is a precarious affair, because the intention must be kept cognitively accessible while its behavioral enactment must be delayed to avoid premature action. Consequently, the cognitive maintenance of an intention is accompanied by inhibition of automatic behavioral routines, or 'volitional inhibition' (Kuhl & Kazén, 1999). Releasing this inhibition is critical for flexible and efficient action. However, not everyone is equally capable of releasing volitional inhibition (Kuhl, 1994, 2000). So-called 'action-oriented' people are capable of releasing volitional inhibition rapidly and efficiently. Consequently, action-oriented people can execute difficult intended actions in a flexible and context-sensitive manner. By contrast, so-called 'state-oriented' people find it difficult to release volitional inhibition after forming an intention. As a result, state-oriented people are prone to maintain their intentions in a narrow linguistic format that is disconnected from implicit knowledge structures about the self and the world that are needed for context-sensitive action. If an intention is no more than a collection of words, then merely rehearsing these words will not promote action. In fact, rehearsing the linguistic representation of an intention may amplify behavioral passivity by strengthening volitional inhibition. This *over-maintenance hypothesis* can thus explain the seeming paradox that cognitively maintaining an intention may render state-oriented people less capable of enacting this intention (see also Kuhl, 2000).

Consistent with the over-maintenance hypothesis, state-oriented people are more inclined than action-oriented people to mentally rehearse their intentions (Goschke & Kuhl, 1993). At the same time, state-oriented people are less likely to enact difficult intentions than their action-oriented counterparts (e.g., Jostmann & Gieselmann, 2014; Jostmann & Koole, 2007; Kazén, Kaschel, & Kuhl, 2008). For instance, state-oriented people display greater interference in a Stroop color-naming task than action-oriented people, particularly under demanding conditions that call on proactive control (Jostmann & Koole, 2007). State-oriented people are also less likely to enact difficult intentions in everyday contexts, such as sticking with a diet (Palfai, 2002), finding employment (Song, Wanberg, Niu, & Xie, 2006), or breaking one's personal athletic record (Heckhausen & Strang, 1988). Taken together, converging lines of research indicate that state-oriented people display high cognitive activation of intentions accompanied by low behavioral enactment of these same intentions (for reviews, see Jostmann & Koole, 2007; Koole, Jostmann, & Baumann, 2012; Kuhl & Beckmann, 1994).

The heightened cognitive maintenance of intentions and their reduced enactment among state-oriented individuals has so far been observed in separate lines of research. It thus remains to be seen whether cognitively maintaining intentions indeed keeps state-oriented people from enacting these intentions, as the over-

maintenance hypothesis suggests. Indeed, recent research has challenged the viability of the over-maintenance hypothesis. Specifically, Jostmann and Koole (2007, Study 3) found that state-oriented people displayed greater interference in a Stroop task when the intention was not pre-cued compared to when the intention was pre-cued. Performance decrements that occur only in the absence of pre-cues are often attributed to goal neglect (Kane & Engle, 2003). A goal neglect account implies that state-oriented people think too little about their intentions, which contradicts the over-maintenance hypothesis. However, tasks without pre-cues also require more proactive control (Braver et al., 2007), which is impaired by over-maintenance processes (Baumann, Kaschel & Kuhl, 2005; Kazén et al., 2008). It thus remains ambiguous whether control deficits among state-oriented people are caused by over-maintenance processes.

In the present research, we sought to provide a direct test of the over-maintenance hypothesis. In two studies, we examined participants' performance of difficult actions in a Stroop task (Study 3.1) or a task-switching paradigm (Study 3.2). We manipulated how strongly participants focused on their intentions using verbal instructions. Under strong intention focus, participants consciously focused their attention in determining their responses. Under weak intention focus, participants let the right answers come to them without applying extra effort. In line with the over-maintenance hypothesis, we predicted that state-oriented people would perform difficult actions less efficiently when focusing more strongly on their intentions. We predicted no such pattern for action-oriented people. Indeed, if anything, we expected that focusing on intentions would lead action-oriented people to mobilize additional self-regulatory resources, and thus improved execution of difficult actions (see Koole et al., 2012).

State-oriented people more readily display physiological arousal in response to increased task demands, arousal that may cause state-oriented people to underperform (Heckhausen & Strang, 1988). Such over-arousal effects may be a byproduct of over-maintenance of intentions, especially when enacting the intention is both important and effortful (Brehm & Self, 1989). However, over-maintenance of intentions is primarily a cognitive process, which may occur even when task-related increases in arousal are too small to push people beyond their optimal level. Because performance incentives were modest in the present studies, our participants would be expected to display little physiological arousal (Brehm & Self, 1989). We therefore expected state-oriented participants to show over-maintenance without over-arousal. Empirically, we took several steps to establish the role of arousal in our results. First, we asked participants to report any changes in experienced arousal and examined whether these changes mediated our effects. Second, we measured two behavioral signatures of arousal: Facilitation of habitual responses in Study 3.1 (Hull,

1943; Pelham & Neter, 1995) and distractibility in Study 3.2 (Eysenck, Derakshan, Santos, & Calvo, 2007). We expected to find over-maintenance effects among our state-oriented participants, even in the absence of increased self-report or behavioral manifestations of arousal.

Study 3.1

Study 3.1 examined the joint influence of intention focus and action-state orientation in a Stroop (1935) task, one of the most widely used paradigms within psychology for studying how people can implement difficult actions (MacLeod, 1991). Participants had to respond to the color of a word while ignoring the word meanings. The meaning of the words was either neutral (a string of X-es), congruent (e.g., the word blue written in a blue color) or incongruent (e.g., the word blue written in a red color). Experienced readers tend to make more mistakes and respond more slowly during incongruent trials, a phenomenon known as Stroop interference (MacLeod, 1991). During the Stroop task, we used verbal instructions to manipulate how strongly participants were focused on their color-naming intentions.

Theoretically, the effects of intention focus and action-state orientation are most likely to emerge during incongruent Stroop trials. This is because incongruent Stroop trials are difficult to enact, due to the conflict between the task goal of color naming and the over-learned inclination to read the words. Resolving the Stroop conflict presumably requires proactive, volitional effort. In line with the over-maintenance hypothesis, we predicted that focusing more strongly (rather than weakly) on the color-naming intention would render state-oriented participants less capable of inhibiting their automatic inclination to read the word meanings, leading to greater Stroop interference. Conversely, we predicted that focusing more strongly (rather than weakly) on the color-naming intention would mobilize proactive control among action-oriented participants, leading to less Stroop interference.

We used a version of the Stroop task with a relatively high proportion (75%) of congruent trials, because the effects of action-state orientation are usually most pronounced in high-congruency contexts (Jostmann & Koole, 2007). High-congruency versions of the Stroop task typically find most variance on error rates rather than response latencies (Jostmann & Koole, 2007, study 3; Kane & Engle, 2003). Presumably, this is because participants only infrequently need to implement proactive control in the high-congruency context, which makes it tempting to become more passive and may hence foster lapses in proactive control (Kane & Engle, 2003). Whenever such lapses occur, errors become more likely because incongruent stimuli are not noticed in time. When incongruent trials go unnoticed, they can no longer cause a slow-down

in response times. In view of these considerations, we expected the effects of action-state orientation and intention focus to arise mainly for error rates.

Finally, we assessed in Study 3.1 in how far the effects of intention focus and action-state orientation might be due to arousal processes. To this end, we asked participants to report any changes in arousal and mood before and after the Stroop task. We further derived behavioral measure of arousal from the Stroop task. A classic law in motivation research holds that increased arousal facilitates habitual behavior (Hull, 1943; Pelham & Neter, 1995). Consequently, if our manipulation of intention focus increased arousal among state-oriented people, we would expect intention focus to increase Stroop facilitation among this group. Given the low-arousing nature of our procedures, however, we expected to find no effects of intention focus and action-state orientation on either self-reported arousal, mood, or Stroop facilitation.

| Method

Participants and Design

Sixty-three volunteers (46 female and 17 male, average age 21) at the VU University Amsterdam participated for study credits or money. Participants varying in action versus state orientation were randomly assigned to strong or weak intention focus conditions. The main dependent variable consisted of error rates during the Stroop task.

Materials and Procedure

Participants were received by a female experimenter and escorted to individual cubicles. All instructions were computer-administered. Participants were first informed that they participated in several brief unrelated studies that were administered together for efficiency reasons. Participants then filled out some personality questionnaires, which included a measure of individual differences in action versus state orientation. Next, participants rated their mood and completed a Stroop task. The intention focus manipulation was introduced during the Stroop task. After this, participants rated their mood for a second time, completed a color blindness test, and answered some biographical questions. Finally, participants were debriefed, thanked, and rewarded for their contribution.

*Action versus State Orientation***.** Individual differences in action versus state orientation were assessed with the decisiveness subscale of the Action Control Scale (ACS90; Kuhl, 1994). The ACS90 has been validated extensively in over 80 studies (see Koole et al., 2012, for a review). Throughout these studies, decisiveness has emerged as a robust predictor of how people deal with demanding conditions in controlled laboratory tasks (e.g., Jostmann & Koole, 2006, 2007; Kazén et al., 2008) and in real-life settings such as

work (Diefendorff, Richard, & Gosserand, 2006; Jaramillo & Spector, 2004), education (Boekaerts & Otten, 1993; Diefendorff, 2004), and health (Palfai, McNally, & Roy, 2002). Each of the 12 items of the decisiveness scale describe a demanding situation and two ways of dealing with the situation (Cronbach's α = .73). One alternative always corresponds with an action-oriented way of coping; the other with a state-oriented way of coping. An illustrative item is, 'When I have to take care of something important which is also unpleasant: a) I do it and get it over with, b) It can take a while before I can bring myself to it'. In this case, answer *a* is scored as action-oriented and answer *b* is scored as state-oriented (in the actual scale, order of action- versus state-oriented answers is counterbalanced). Participants who gave 6 or more action-oriented responses were categorized as 'action-oriented'. Participants who gave 5 or fewer action-oriented responses were categorized as 'state-oriented'. The same substantive results emerged when we analyzed action control scores as a continuous variable[4].

Mood Assessment. Participants' mood was assessed using a self-report inventory developed by Kuhl and associates translated into Dutch (e.g., Kazén et al., 2008). During each of the two mood assessments, participants rated how well 23 mood adjectives (e.g., tense, listless, joyful) applied to their current feelings, using 4-point Likert scales (from 1 = not at all, to 4 = completely). The adjectives were averaged into a single index of negative mood (Cronbach's α = .88).

*Stroop Task***.** Participants completed 160 trials, out of which 60 were target trials that were used for analysis. The target trials consisted of 20 congruent, 20 incongruent and 20 neutral trials. During congruent trials, the words RED or BLUE were presented in matching colors. During incongruent trials, the words were presented in mismatching colors. During neutral trials, four crosses (XXXX) were presented in either blue or red font. The remaining 100 trials contained words that were congruent with the font colors. All color words and font colors were equally represented across filler and target trials, except for the neutral letter string *XXXX,* which was only presented during target trials. Presentation order of the trials was varied randomly for each participant.
Each trial started with a fixation cross that was presented for 1,000 milliseconds in the center of the screen, which was immediately followed by the presentation of a letter-string. After participants responded, the screen went blank for 2,000 milliseconds until the next fixation appeared. Before the actual task, participants practiced with six trials for which they received feedback. Participants answered by pressing the *A* on the computer keyboard to indicate that the color of the word was red or the 6 on the numeric pad of the keyboard to indicate that the color was blue.

4. In Study 3.1, a parallel analysis with action orientation as a continuous variable yielded a marginally significant interaction between intention focus and action orientation on Stroop interference, $F(1, 55) = 3.3$, $p = .07$, $\eta_p^2 = .06$.

Intention Focus Manipulation. After participants received the instructions for the Stroop task, we introduced our experimental manipulation of intention focus. We modeled our intention focus manipulation after the procedures of Smilek, Enns, Eastwood, and Merikle (2006). The latter researchers instructed participants to actively or passively guide their attention in visual search tasks. Their results showed that passive instructions reduced reliance on executive control processes, whereas active instructions increased reliance on executive control processes. These findings confirm that it is possible to manipulate how strongly people are focused on their intentions through simple task instructions.

In the weak intention focus condition, participants were instructed to approach the task in a way that would minimize their reliance on conscious intentions. Specifically, participants were presented with the following instructions:

> *The best strategy for performing this task is to relax.*
> *Open yourself to the colors that you will see and let the right answer emerge in you.*
> *Let what you see on the screen together with your feelings determine your response.*
> *Some people find it hard to trust their feelings in this manner.*
> *Please still do your best to do it like this.*
> *Try to respond as quickly and as accurately as possible, while using this strategy.*
> *So just let the right answer pop into your mind.*

In the strong intention focus condition, participants received a parallel set of instructions that were intended to maximize participants' reliance on explicit intentions. Specifically, participants were presented with the following instructions:

> *The best strategy for performing this task is to be as active as possible*
> *Focus on the color of the letters and not on the words that they form.*
> *Use your conscious attention to give the right response.*
> *Some people find it hard to consciously focus their attention in this manner.*
> *Please still do your best to do it like this.*
> *Try to respond as quickly and as accurately as possible, while using this strategy.*
> *So focus your attention on the color of the letters and not on the words.*

It should be noted that in both intention focus conditions, the instructions clearly stated that participants were to focus on naming the ink colors. We thus tried to keep the task goal equally specific in both conditions. Moreover, in both conditions, we instructed participants to do their best. In this way, we tried to avoid differences in motivation between both conditions. Finally, in both conditions, we instructed participants to try and be as quickly and as accurately as possible. We gave the latter

instruction to avoid that the manipulation would cause a shift in response criteria (e.g., emphasizing speed over accuracy or vice versa).

Results

Stroop Task. Data of three colorblind participants (4.7% of the entire sample) were discarded. Data of one participant (1.6% of the entire sample) were discarded, because he made errors on 50% of all trials during the Stroop task. Our main interest was in error rates, which are usually a more sensitive measure of cognitive control than response times for Study 3.1's high-congruency version of the Stroop task. Indeed, as in prior research (Jostmann & Koole, 2007; Kane & Engle, 2003), there were no effects of action orientation or intention focus on response times, Fs < 1.51, ps >.23.

Participants generally made more errors during incongruent trials (M = 1.49, SD = 1.71) than during neutral trials (M = 0.48, SD = 0.68), $t(58) = 4.45$, $p < .001$, Cohen's d = 0.78. Participants did not differ in error rates during congruent trials (M = 0.37, SD = 0.79) and error rates during neutral trials, $t(58) = -0.81$, $p = .42$. Thus, participants' error rates showed reliable Stroop interference effects, but no facilitation effects. Preliminary analyses revealed no effects of action versus state orientation and intention focus on Stroop facilitation, all Fs < 2.3, ps > .13. We therefore discuss only the results for Stroop interference.

A 2 (orientation: action vs. state; between subjects) x 2 (intention focus: weak vs. strong; between subjects) x 2 (trial type: incongruent vs. neutral; within subjects) analysis of variance (ANOVA) revealed the predicted three-way interaction effect between orientation, intention focus, and trial type $F(1, 55) = 7.42$, $p = .009$, $\eta_p^2 = .12$. Relevant means are displayed in Table 3.1. For ease of interpretation, we computed an index of Stroop interference by subtracting the number of errors during neutral trials from the number of errors in response to incongruent trials. The effects of action control and intention focus on Stroop interference are visually displayed in Figure 3.1. Next, we conducted separate follow-up tests by intention focus condition. In the strong intention focus condition, state-oriented participants had more Stroop interference than action-oriented participants, $F(1, 55) = 7.17$, $p = .01$, $\eta_p^2 = .12$. In the weak intention focus condition, the pattern was reversed, such that action-oriented participants showed more interference than state-oriented participants, although the latter effect was not significant, $F(1, 55) = 1.36$, $p = .25$, $\eta_p^2 = .02$. Another way to interpret the interaction between intention focus and orientation is to note that action-oriented participants had less Stroop interference in the strong intention focus condition than in the weak intention focus condition, although the effect was not significant, $F(1, 55) = 2.36$, $p = .13$, $\eta_p^2 = .04$. The opposite pattern was found among

state-oriented participants, among whom Stroop interference was significantly greater in the strong intention focus condition than in the weak intention focus condition, $F(1,55) = 5.46$, $p = .02$, $\eta_p^2 = .09$.

| Table 3.1.

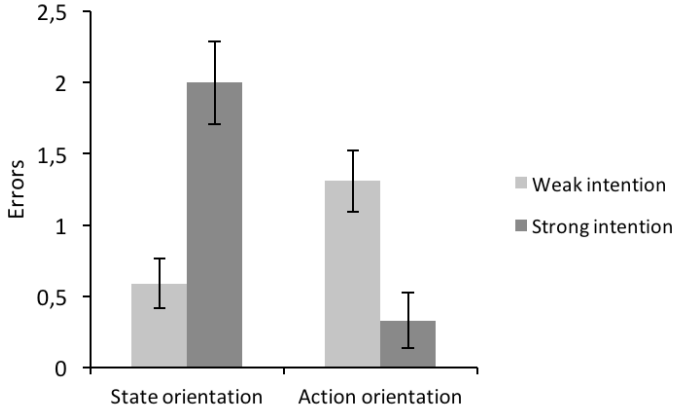
Mean Errors in Color Naming (Standard Deviations Between Brackets) as a Function of Intention Focus, Orientation, and Trial Type (Study 3.1)

		Trial Type		
Intention Focus		**Incongruent M (SD)**	**Neutral M (SD)**	**Stroop Interference**
Strong	Action-oriented (a)	0.86 (1.25)	0.53 (0.74)	0.33 (1.49)
	State-oriented (b)	2.43 (2.47)	0.43 (0.65)	2.00 (2.18)
Weak	Action-oriented (c)	1.54 (1.39)	0.23 (0.44)	1.31 (1.55)
	State-oriented (d)	1.24 (1.25)	0.65 (0.79)	0.59 (1.42)

(a) N = 15, (b) N = 14, (c) N = 13, (d) N = 17

| Figure 3.1.

Stroop Interference as a Function of Action-State Orientation and Intention Focus (Study 3.1)



Mood. We conducted a 2 (orientation) x 2 (intention focus) x 2 (time of measurement: before versus after Stroop task; within subjects) ANOVA on participants' global mood scores. There was a main effect of time of measurement: Participants experienced more negative moods after completing the Stroop task, $F(1, 58) = 17.66$, $p < .001$, $\eta_p^2 = .23$ ($M = 1.87$, $SD = .43$ versus $M = 2.06$, $SD = .42$). Notably, mood scores during the entire experiment remained close to the conceptual midpoint of the 4-point Likert scales that were used. Thus, the observed mood differences were of mild intensity.

There were no effects involving an interaction between orientation and intention focus, *F*s < 1. Furthermore, there were no main effects of orientation nor of intention focus on mood, all *F*s < 2.71, ps < .11. Finally, statistically controlling for mood as a covariate did not change the effects of orientation and intention focus in the Stroop task. Thus, there was no indication that the observed pattern in the Stroop task was mediated by mood.

Discussion

The effects of intention focus on Stroop interference were moderated by action versus state orientation. When intention focus was strong, state-oriented participants had significantly more Stroop interference than when intention focus was weak. The latter finding is consistent with the over-maintenance hypothesis, which holds that control deficits among state-oriented people arise when they become cognitively preoccupied by their intentions. Action-oriented participants displayed no evidence of an over-maintenance pattern. In fact, there was a non-significant trend such that strong (rather than weak) intention focus reduced Stroop interference among action-oriented participants. Focusing on intentions may thus facilitate the ability of action-oriented participants to enact difficult intentions. However, more research is needed to confirm this idea, because the latter finding fell short of statistical significance. Participants' self-reported mood changes provided no indication that intention focus increased participants' arousal or self-reported mood. Furthermore, there were no effects of intention focus or action-state orientation on Stroop facilitation. The latter may be regarded as a behavioral index of arousal, given that arousal is known to facilitate habitual action (Hull, 1943; Pelham & Neter, 1995) and hence can be expected to increase Stroop facilitation. Thus, it appears that Study 3.1's over-maintenance pattern among state-oriented people cannot be explained in terms of over-arousal.

Study 3.2

In Study 3.2, we used a task-switching paradigm that was developed by Dreisbach and Goschke (2004) to examine the over-maintenance hypothesis. In the first stage of this paradigm, participants categorize stimuli in a specific color while ignoring distracter stimuli in a different color. After a while, the task goal is changed such that participants have to categorize stimuli in a new target color, while distracters appear in the color of the former target. To perform well during the second stage,

participants have to mentally disengage from their old task goal. We suspected that over-maintenance makes this mental disengagement more difficult, leading to more perseveration of the old task goal. If this is correct, then state-oriented people should display stronger perseveration in the Dreisbach and Goschke paradigm, especially when they are strongly focused on their intentions. Action-oriented people should be relatively immune to this effect, because of their ability to flexibly disengage from their intentions. We examined these predictions in Study 3.2.

We further conducted a more refined test of the over-maintenance hypothesis, by defining more specifically in what sense state-oriented people over-maintain their intentions. In particular, we suggest that over-maintenance processes lead state-oriented people to encode goal-related stimuli more strongly in linguistic terms. If this is correct, then state-oriented people can be expected to display lower distractibility by goal-irrelevant information. Notably, this prediction is opposite to an over-arousal explanation, because arousal usually increases distractibility by goal-irrelevant information (Eysenck et al., 2007). In the Dreisbach and Goschke task, one can derive distractibility scores by comparing response latencies for different types of trials. In compatible trials, the target and distracter require the same response. In incompatible trials, target and distracter require different responses. Based on the over-maintenance hypothesis, we predicted that state-oriented people should show lower distractibility in the Dreisbach and Goschke task when they focused more (rather than less) on their intentions.

At first glance, the notion that intention focus should lower distractibility among state-oriented people might seem at odds with Study 3.1's finding that intention focus increased Stroop interference among state-oriented people. However, Stroop interference stems from the over-learned activation of reading tendencies among skilled readers, so that overcoming Stroop interference requires effortful control (e.g., Kuhl & Kazén, 1999; Morsella, Wilson, Berger, Honhongva, Gazzakey, & Bargh, 2009). By contrast, reduced distractibility among state-oriented people is presumably due to an automatic (but goal-dependent) linguistic encoding process. In the social-cognitive literature, this mechanism is also known as "goal shielding" (Achtziger, Gollwitzer, & Sheeran, 2008; Mc Culloch, Aarts, Fujita, & Bargh, 2008; Shah, Friedman, & Kruglanski, 2002; Veling & Van Knippenberg, 2006, 2008). Because goal shielding is automatic, it applies only to relatively effortless tasks that can be delegated to automatic linguistic encoding processes. Consequently, the Stroop task of Study 3.1 was an unlikely context for goal shielding to emerge. In less effortful tasks, however, we would expect to find goal shielding (i.e., reduced distractibility) among state-oriented people who are focusing on their task goal.

In the Dreisbach and Goschke (2004) paradigm, the categorization task that participants perform is relatively easy prior to the switch in task goal, because a)

the distracters do not trigger over-learned responses, as in the Stroop task; and b) there is not yet interference from an old task goal. Participants may thus perform this task fairly effortlessly, provided that they properly encoded the task instruction. Accordingly, we predicted that intention focus would lead to lower distractibility effects among state-oriented participants during the first stage of the Dreisbach and Goschke task. In the second stage of the Dreisbach and Goschke (2004) paradigm, however, the task becomes more effortful because there is interference from the old task goal. We therefore predicted that intention focus would no longer lower distractibility among state-oriented participants during the second stage of the task. Finally, we expected none of these distractibility effects to emerge among action-oriented people, because the latter rely less on automatic, relatively rigid forms of goal shielding (Goschke & Kuhl, 1993).

| Method

Participants and Design

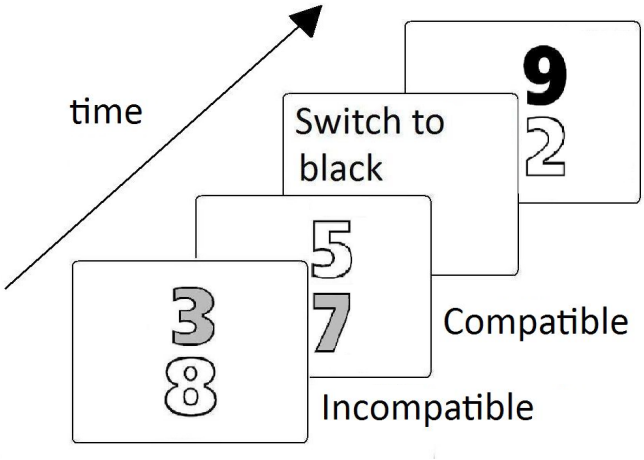
Sixty-nine volunteers (48 female and 21 male, average age 20) at the VU University Amsterdam participated for study credits or money. Participants with varying dispositional action versus state orientation were randomly assigned to the weak intention focus versus strong intention focus conditions. The main dependent variable consisted of response times during the symbol categorization task.

Materials and procedure

The equipment, assessment of action-state orientation (Cronbach's α = .78), mood assessment (Cronbach's α = .88), and intention focus manipulation were similar to Study 3.1. The main difference was that we used the paradigm developed by Dreisbach and Goschke (2004). Figure 3.2 provides a schematic representation of the task. Participants initially categorize target stimuli in a specific color while ignoring distracter stimuli in a different color. After this, participants have to categorize stimuli in a new target color, while distracters appear in the former target color. During this second stage, difficulties in disengaging from the old task goal presumably reflect perseveration tendencies.

| Figure 3.2.

The Perseveration Task



In this example, the white digit is the target stimulus during the first run. In the second run, the black digit becomes the target while the white digit serves as the distracter.

Participants performed the task during three separate runs. Each run consisted of two stages of respectively 40 and 20 trials. During each run, we manipulated intention focus. The instructions were parallel to those we used in Study 3.1. Only this time, instead of focusing on the colors of the words, participants in the strong intention focus were told to, "Focus consciously on the color you were asked to respond to and on recognizing characteristics like vowel/consonant "Likewise, instead of opening themselves to the colors, participants in the weak intention focus were told to, ". Open yourself to the colors that you will see and for characteristics like vowel/consonant and let the right answer emerge in you". The manipulation was otherwise identical to Study 3.1.

When the sequence contained digits the word 'letter' was replaced by 'digit' and the words 'consonant' and 'vowel' by 'odd' and 'even'. Participants were informed about the task switch after the first stage. Feedback was provided only during the first 22 training trials. After Dreisbach and Goschke (2004), whether the stages contained trials consisting of digits or numbers was randomly varied between participants; half of the participants completing only the digit task, the other half completing only the letter task.

During each trial, two digits (2, 3, 4, 5, 6, 7, 8, or 9; in olive, purple or grey colors) or two letters (A, E, O, U, K, M, R, or S; in red, yellow or blue) were presented simultaneously above each other in two different colors. This led to twelve possible sequences of target and distracter colors (six for letters and six for digits). These twelve sequences

were equally counterbalanced between participants. Participants had to respond only to the digit or letter in the target color and to categorize it as even or odd, or as a vowel or a consonant by pressing the "A" or the "6" on the keyboard. Participants had to ignore the simultaneously presented letter or digit in the distracter color.

During compatible trials, the two digits or letters required the same response (e.g., both letters were vowels). During incompatible trials, the two digits or letters required different responses (e.g. the distracter was a vowel and the target was a consonant). Each trial started with a fixation cross that remained on screen for 250 ms, followed by the digits or letters that remained on the screen until a response was given. After participants gave a response, a blank screen was displayed for 500 ms before a new trial started.

Results

Categorization Task. Data of six colorblind participants (9.8% of the entire sample) were discarded, and data of three participants (4.9% of the entire sample) were not analyzed because of a programming error. Similar to Dreisbach and Goschke (2004), the analysis yielded no effects of our design factors on error rates. We therefore report only the effects for participants' response times. Response times below 150 ms and above 2,000 ms were excluded from analysis, as were errors (6% of all trials). The most theoretically meaningful comparison was between mean response times during the remaining five trials immediately before the task goal switch (the last five compatible as well as the last five incompatible trials of the first stage) and mean response times during the remaining five trials immediately after the task goal switch (the first five compatible as well as the first five incompatible trials of the second stage). We made this comparison separately for compatible and incompatible trials. Unexpectedly, we only found effects of action versus state orientation for the first two tasks, and the effect diminished during the third task. Although we did not a priori predict this pattern, prior research has found that the importance of action orientation decreases as cognitive tasks become more well-rehearsed, and presumably less in need of proactive control (see Jostmann & Koole, 2007, Study 2, on practice effects). The absence of a main effect of perseveration in the third block supports the notion that practice effects became more potent at this stage, $F(1, 55) = 2.11$, $p = .15$, $\eta_p^2 = .037$. Moreover, the relevant three-way interaction between orientation (action- vs. state; between subjects), intention focus (weak vs. strong; between subjects) and stage (before vs. after task switch; within participants) was not significant for incompatible trials $F(1, 55) = 1.72$, $p = .20$, $\eta_p^2 = .03$. We therefore concentrate on the results for the first two tasks.

We subjected response times to a 2 (orientation: action- vs. state; between subjects) x 2 (intention focus; weak vs. strong; between subjects) x 2 (stage: before vs. after task switch; within participants) x 2 (trial type: compatible vs. incompatible; within participants) ANOVA. This analysis yielded a three-way interaction between orientation, intention focus, and task interval, $F(1, 55) = 4.46$, $p = .04$, $\eta_p^2 = .08$, qualified by the predicted four-way interaction between orientation, intention focus, task interval and trial type, although marginally significant, $F(1, 55) = 3.42$, $p = .07$, $\eta_p^2 = .06$[4]. Relevant means are displayed in Table 3.2.

Distractibility. We first turned to distractibility effects, which we computed by subtracting average response times in compatible trials from average response times in incompatible trials. Higher numbers indicate a greater slow-down during incompatible (versus compatible) trials, and thus distractibility by information that is incompatible with the task goal. Recall that, according to the over-maintenance hypothesis, a strong (rather than weak) intention focus should lower distractibility among state-oriented participants. Moreover, this effect should mainly occur during the first stage of the Dreisbach and Goschke (2004) task, which was relatively easy and hence more sensitive to automatic goal shielding (Shah, Friedman, & Kruglanski, 2002).

| Table 3.2.

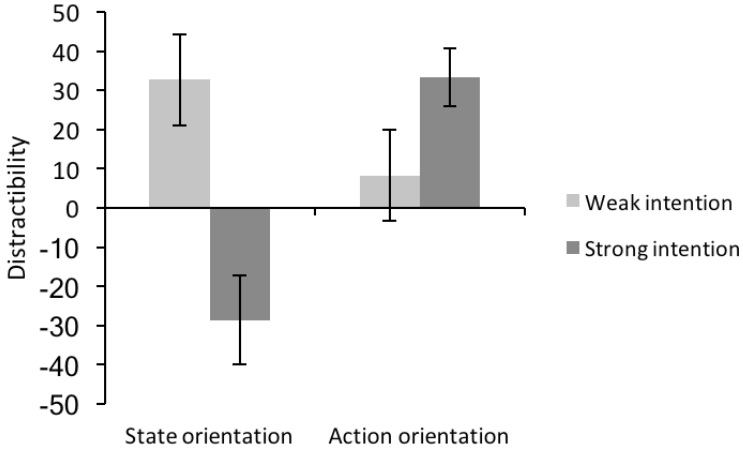
Mean Response Times (Standard Deviations Between Brackets) in the Categorization Task as a Function of Intention Focus, Orientation, and Trial Type (Study 3.2)

		Compatible		Incompatible		Perseveration Effect	
Intention Focus		**First Block** *M (SD)*	**Second Block** *M (SD)*	**First block** *M (SD)*	**Second Block** *M (SD)*	**Compatible** *M (SD)*	**Incompatible** *M (SD)*
Strong	Action-oriented (a)	597.64 (84.74)	629.45 (111.59)	630.97 (90.99)	647.47 (112.59)	31.81 (65.02)	16.50 (74.68)
	State-oriented (b)	639.72 (133.99)	624.94 (117.29)	611.09 (108.85)	679.29 (128.46)	-14.78 (86.84)	68.21 (81.21)
Weak	Action-oriented (c)	559.25 (70.57)	583.49 (117.18)	567.46 (87.29)	606.06 (113.45)	24.25 (82.14)	38.60 (97.71)
	State-oriented (d)	590.06 (90.34)	573.04 (82.34)	622.74 (114.69)	600.10 (78.39)	-17.02 (65.05)	-22.64 (83.92)

(a) *N* = 16, (b) *N* = 16, (c) *N = 11*, (d) *N = 16*

Figure 3.3.

Distractibility as a Function of Action-State Orientation, and Intention Focus Before the Change in Task Goals (Study 3.2)



In the first stage of the task (i.e., before the change in task goal), we found the predicted orientation by intention focus interaction, $F(1,55) = 4.01$, $p = .05$, $\eta_p^2 = .07$. This interaction is graphically displayed in Figure 3.3. State-oriented participants displayed less distractibility under strong (rather than weak) intention focus, $F(1,55) = 4.49$, $p = .04$ $\eta_p^2 = .08$. Conversely, action-oriented participants displayed somewhat more distractibility with strong (rather than weak) intention focus, although the latter effect was not significant, $F(1,55) = 0.61$, $p = .44$, $\eta_p^2 = .01$. Another way to interpret these data is to note that, in the strong intention focus condition, state-oriented participants displayed significantly less distractibility than action-oriented participants, $F(1,55) = 4.59$, $p = .04$, $\eta_p^2 = .08$. In the weak intention focus condition, the difference in distractibility between action- and state-oriented participants was not significant, $F(1,55) = 0.58$, $p = .45$, $\eta_p^2 = .01$. During the second stage of the task (i.e., after the task goal had changed), there were no significant effects of intention focus or orientation, *ps* > .38.

Perseveration. We next turned to perseveration effects. In Dreisbach and Goschke's (2004) experiments, perseveration effects were observed for incompatible trials, but not for compatible trials. Thus, we ran separate analyses for each trial type. For compatible trials, there was a significant two-way interaction between orientation and task interval, $F(1,55) = 4.96$, $p = .03$, $\eta_p^2 = .08$.. Action-oriented participants were faster to respond before the switch ($M = 582$, $SD = 80$) than after the switch ($M = 611$,

SD = 114). State-oriented participants, on the other hand, were slower to respond before the switch (*M* = 615, *SD* = 115) than after the switch (*M* = 599, *SD* = 103). The latter effect was unexpected, so we are cautious to interpret it here. There were no other significant main or interaction effects $p > .54$ for compatible trials.

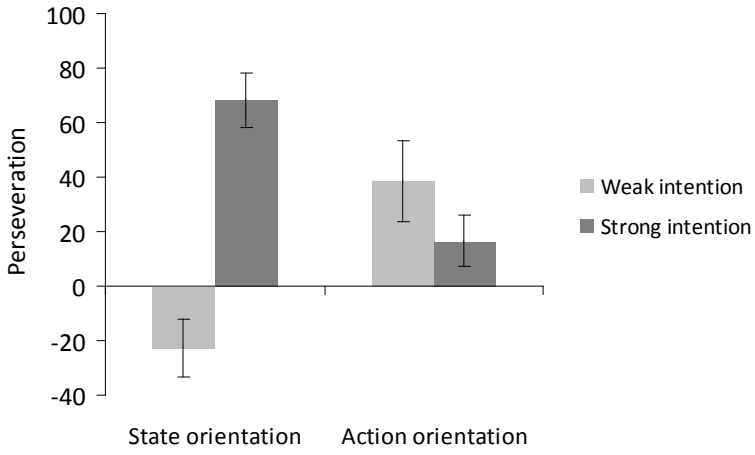
For incompatible trials, there was a significant three-way interaction between orientation, intention focus, and task interval, $F(1, 55) = 7.13$, $p = .01$, $\eta_p^2 = .12$[5]. To facilitate interpretation, we subtracted response times to incompatible trials before the change in task goals from response times to incompatible trials after the change in task goals. The resulting values represent perseveration effects for incompatible trials. For convenience, we refer to these values as simply 'perseveration'. The interaction between orientation and intention focus is graphically displayed in Figure 3.4. Follow-up tests revealed that strong (rather than weak) intention focus led state-oriented participants to display *more* perseveration, $F(1, 55) = 10.27$, $p = .002$, $\eta_p^2 = .16$. Conversely, strong (rather than weak) intention focus led action-oriented participants to display somewhat less perseveration, although the latter effect was not significant, $F(1, 55) = 0.50$, $p = .49$, $\eta_p^2 = .01$. Another way to interpret this pattern is to note that, when intention focus was strong, state-oriented participants displayed marginally *more* perseveration than action-oriented participants, $F(1, 55) = 3.33$, $p = .07$, $\eta_p^2 = .06$. By contrast, when intention focus was weak, state-oriented participants displayed marginally *less* perseveration than action-oriented participants, $F(1, 55) = 3.80$, $p = .056$, $\eta_p^2 = .07$.

Mood. We conducted a 2 (orientation) x 2 (intention focus) x 2 (time of measurement) ANOVA on participants' global mood scores. This analysis yielded only a main effect of time of measurement, $F(1,55) = 3.97$, $p = .05$, $\eta_p^2 = .07$. Participants had a slightly more negative mood after the task (*M* = 1.91, *SD* = 0.43) compared to before the task (*M* = 1.80, *SD* = 0.43). As in Study 3.1, mood scores in Study 3.2 remained close to the conceptual midpoint of the 4-point Likert scales that were used. Thus, participants' average moods remained neutral throughout Study 3.2. Importantly, when we included negative mood changes as a covariate in our statistical analyses of the perseveration task, the effects of intention focus and orientation remained unchanged. In short, there was no indication that the findings in Study 3.2 were mediated by mood.

5. In Study 3.2, , a parallel analysis with action orientation as a continuous variable yielded a significant interaction between intention focus and action orientation on perseveration, $F(1, 55) = 5.78$, $p = .02$, $\eta_p^2 = .09$.

Figure 3.4.

Perseveration on Incompatible Trials as a Function of Action-State Orientation and Intention Focus (Study 3.2)



Discussion

In Study 3.2, we examined the effects of action-state orientation and intention focus on a task-switching paradigm (Dreisbach & Goschke, 2004). The results show that a change in task goals strongly influenced the effects of intention focus on action- versus state-oriented participants. Before the switch in task goals, participants had to simply categorize letters or numbers that were accompanied by distracting information. In this relatively simple task context, focusing strongly (rather than weakly) on the task goal led state-oriented participants to become less distracted by information that was incompatible with the task goal. This goal shielding effect (Shah et al., 2002) indicates that our intention focus manipulation indeed led state-oriented to focus more strongly on the task goal. When the task goal changed, state-oriented people no longer displayed goal shielding. Presumably, the change in task goals led state-oriented participants to switch towards more effortful processing, which inhibited automatic goal shielding. The restriction of goal shielding to low-effort tasks also explains why state-oriented participants did not display goal shielding in the incongruent Stroop trials of Study 3.1.

After a new task goal was introduced, however, strong intention focus led state-oriented people to display more perseveration of the old task goal. This pattern of low distractibility before the goal change and high perseveration after the goal change is consistent with the over-maintenance hypothesis. Presumably, focusing on

intentions leads state-oriented people to strongly activate linguistic representations of the task goal, which led to low distractibility in the initial task, when just a single goal was relevant. However, after the task goal has changed, state-oriented people found it difficult to release their old task goal. Another way of interpreting this pattern is to state that increased intention focus led state-oriented participants to display reduced distractibility, as indicated by reduced interference from incompatible information. However, this reduction in distractibility came at the cost of increased rigidity, in the form of increased perseveration of old task sets.

There was a trend for action-oriented participants to display less goal shielding (i.e., more distractibility) when they focused more strongly on their intentions. The latter trend may seem counterintuitive. However, it should be noted that goal shielding is theoretically a relatively automatic mechanism, which is presumably not driven by higher volitional processes. For instance, Stroebe et al. (2012) showed that goal shielding can lead people to become sidetracked from their long-term goals (i.e., maintaining a healthy diet, is presumably volitional for most people) by short-term hedonic goals (i.e., indulging in junk food). To prevent such goal conflicts, action-oriented people may rely more on higher-level volitional processes when they are actively focusing on their intentions. This approach invoked the cost of increased distractibility among action-oriented people when only a single goal was relevant (i.e., before the change in task goals). After the change in task goals, however, the approach of action-oriented people paid off in terms of reduced perseveration of old task goals.

| Meta-Analysis of Studies 3.1-3.2

Although the patterns in Studies 3.1-3.2 were consistent with expectations and the predicted interaction effects were significant, the observed contrasts were not always statistically reliable. Moreover, both studies had relatively low numbers of participants per cell, and hence low statistical power to detect moderately strong effects. To address this problem, we conducted a meta-analysis of the central findings of both studies. Although the tasks we used in the two studies differed in many particulars, they both included trials in which participants had to use proactive control to execute difficult actions. In Study 3.1, the theoretically relevant trials were those involving Stroop interference; in Study 3.2, the theoretically relevant trials were those involving perseveration effects.

We obtained average Stroop interference effects from Study 3.1, and average perseveration effects of incompatible trials from Study 3.2. To ensure comparability across tasks, we standardized these outcome variables. Preliminary analyses showed

no effects of type of task, $p > .89$, so we combined scores on the two tasks into a single measure of volitional action control. On the resulting values, we performed a 2 (orientation: action vs. state; between subjects) 2 (intention focus: weak versus strong; between subjects) ANOVA. This analysis yielded the predicted interaction between orientation and focus, $F(1, 113) = 11.36$, $p = .001$, $\eta_p^2 = .09$.

We proceeded by examining the effects separately for action- and state-oriented people. State-oriented participants showed poorer action control in the strong intention focus condition than in the weak intention focus condition, $F(1, 113) = 5.82$, $p = .02$, $\eta_p^2 = .05$. By contrast, action-oriented participants showed better action control in the strong intention focus condition than in the weak intention focus condition, $F(1,113) = 5.57$, $p = .02$, $\eta_p^2 = .05$. Another way to interpret the intention focus by action control interaction is to note that performance of action- and state-oriented people differed by intention focus. In the strong intention focus condition, state-oriented participants displayed less effective action control than action-oriented participants, $F(1, 113) = 9.61$, $p = .002.$, $\eta_p^2 = .08$. By contrast in the weak intention focus condition, state-oriented participants displayed marginally more effective action control than action-oriented participants, $F(1, 113) = 2.87$, $p = .09.$, $\eta_p^2 = .03$.

General Discussion

In the present research, we took a closer look at the role of intentions in action control. To this end, we experimentally manipulated how strongly people focused on their intentions and examined how this influenced their capacity to execute actions of varying levels of difficulty in a Stroop task (Study 3.1) and a task-switching paradigm (Study 3.2). The results showed that the effects of intention focus were strongly moderated by action versus state orientation. Among action-oriented people, stronger intention focus led to more efficient execution of difficult actions. Among state-oriented people, however, stronger intention focus led to less efficient execution of difficult actions. Focusing on intentions may thus facilitate or impair action control, depending on whether people are action- versus state-oriented.

One explanation for the present findings might be that leading people to focus on their intentions heightens arousal. Conceivably, an increase in arousal might push state-oriented people to "choke under pressure" (Heckhausen & Strang, 1988; see also Baumeister & Showers, 1986; Beilock & Carr, 2005), whereas action-oriented individuals might need this kind of stimulation as a motivational incentive. However, participants' self-reports indicated generally modest levels of arousal throughout the present studies, and no hint of any changes in arousal or mood among our participants that

could explain their performance differences. Furthermore, there were no effects of intention focus or action versus state orientation on a behavioral marker of arousal, namely, facilitation of routine actions in Study 3.1 (i.e., Stroop facilitation, see Eysenck et al., 2007; Hull, 1943; Pelham & Neter, 1995). Consequently, each of the tests that we conducted of the arousal hypothesis came up with negative results.

In our view, the present findings are best explained by differences in the cognitive maintenance of intentions between action- versus state-oriented people. According to the over-maintenance hypothesis, state-oriented people are less able than action-oriented people to connect their intentions to implicit (procedural) knowledge structures that enable the flexible execution of difficult actions. As a consequence, state-oriented people maintain their intentions in a narrow, purely linguistic format that inhibits the behavioral enactment of intentions. The over-maintenance hypothesis predicts that, among state-oriented people, focusing more on intentions paradoxically makes it harder to flexibly enact the intention. Among action-oriented people, intentions are presumably supported by implicit (procedural) knowledge structures, so that focusing on intentions does facilitate action control.

The general pattern of findings in the present two studies is consistent with the over-maintenance hypothesis. Moreover, Study 3.2 provided more detailed insight into the nature of over-maintenance processes among state-oriented individuals. In the latter study, intention focus led state-oriented people to display less distractibility, at least, as long as the task goal remained unchanged. With a change in task goal, however, state-oriented people lost this advantage and instead displayed greater interference by their old task goal in their new task. It thus appears that state-oriented people form more rigid links between a goal and stimuli that are relevant to the enactment of the goal. This narrow format of state-oriented people's intentions presumably allows them more effectively encode goal-relevant information in linguistic terms. However, this linguistic encoding process is relatively inflexible, and cannot be easily deactivated. Furthermore, this linguistic encoding process is incapable of overcoming strong over-learned behavior tendencies, as evidenced by our findings in Study 3.1's Stroop task.

The present research is not without limitations. First, the present studies were conducted in a laboratory setting. Prior research suggests that action orientation moderates enactment of intentions in real life settings, such as work (Diefendorff, Hall, Lord, & Strean, 2000), sports (Heckhausen & Strang, 1988), and health behavior (Palfai, 2002). In such settings, it would be useful to know if intention focus moderates the effects of action versus state orientation. Second, the present studies were mostly oriented towards understanding action-control deficits among state-oriented people. As a result, we devoted less attention to the question how action-oriented people maintain high levels of flexibility in intentional action control. Kuhl (2000) has

suggested that action-oriented people may release volitional inhibition through up-regulation of positive affect. These affect regulation processes presumably operate largely intuitively, on implicit levels (Jostmann, Koole, van der Wulp, & Fockenberg, 2005; Koole & Fockenberg, 2011; Koole & Jostmann, 2004). The relatively coarse self-report mood measures that we used in the present research were probably not sensitive enough to detect such intuitive affect regulation processes. Future research should therefore examine the interplay between over-maintenance and intuitive affect regulation.

Although many questions remain, the present research provides some of the most direct evidence to date that merely focusing on an intention does not automatically warrant that this intention will be translated into action. This point is of great theoretical significance, because traditional expectancy-value models of human motivation have neglected the processes that allow for the implementation of motivational tendencies (Greve, 2001; Heckhausen & Kuhl, 1985; Kuhl, 1987). Likewise, models of goal setting (Locke & Latham, 1990) and goal priming (Custers & Aarts, 2010; Shah, 2005) have assumed that the linguistic representation of a goal is directly linked to behavioral processes of goal implementation. If the latter theoretical models were correct, then focusing on an intention should facilitate action control for everyone. However, the present findings showed that focusing on an intention had the opposite effect among state-oriented people. The implication is that people may fail to act upon their goals even when their goals are the first and foremost thing on their mind. Indeed, people may sometimes fail to act upon their goals *because* their goals are the first thing on their mind. Ironically, thinking about a goal may sometimes (for some people) interfere with people's capacity to act upon this very goal.

CHAPTER 4

On the Dynamics of Control Adaptation: Action versus State Orientation and Sequential Trial Effects in Stroop Interference Tasks

On the Dynamics of Control Adaptation: Action versus State Orientation and Sequential Trial Effects in Stroop Interference Tasks

People vary widely in the efficiency of implementing difficult plans and intentions (Kuhl, 1984). So-called "action-oriented" people tend to be highly efficient at translating difficult intentions into action, especially under demanding conditions. By contrast, the same demanding conditions render so-called "state-oriented" people prone to fall short in realizing their goals. These behavioral differences between action- versus state-oriented individuals has consistently emerged over the last three decades, both in controlled laboratory studies (e.g., Jostmann & Koole, 2006) and in real-life achievement contexts, such as work (Diefendorff, Hall, Lord, & Strean, 2000)), sports (Heckhausen & Strang, 1988), and education (Jaramillo & Spector, 2004).

In view of the aforementioned findings, it is tempting to write off state orientation as a purely self-defeating personality trait. However, we propose a more nuanced, and arguably, more valid, view of the psychology of state-oriented people (Koole, Kuhl, Jostmann, & Vohs, 2005). We acknowledge that state orientation may be a liability in demanding situations where people have to engage in pro-active action control, that is, when people have to initiate difficult actions by themselves. Nevertheless, even in demanding contexts, people may still be provided with cues that tell them when to start exerting effortful action control. For instance, an overworked manager may receive an auto-reminder of her electronic diary about an upcoming meeting. In the latter type of situations, people can rely on more reactive forms of action control. In this article, we suggest that such reactive action control may be especially useful to state-oriented people.

In what follows, we begin by taking a closer look at the literature on individual differences in action versus state orientation and consider how these map onto the distinction between proactive and reactive action control. Next, we turn our attention to a key behavioral signature of reactive control, namely congruency sequence effects in cognitive interference tasks (Ullsperger, Bylmsa & Botvinick, 2005; Gratton, Coles & Donchin, 1992). Based on our theoretical analysis, we explain why state-oriented individuals may be more likely than action-oriented individuals to show congruency sequence effects. Finally, we present two studies that were designed to test our theoretical analysis.

Individual Differences in Action versus State Orientation

The notion of action versus state orientation is derived from a comprehensive theory of human action control (Kuhl, 1984, 1994, 2000). From this perspective, there are important individual differences in people's flexibility of volitional action control. When people are action-oriented, they are in a metastatic (change-promoting) regulatory mode that promotes the flexible formation and implementation of intentions. Action orientation is characterized by decisiveness and initiative under demanding circumstances. By contrast, when people are state-oriented, they are in a catastatic (change preventing) mode of control that impairs people's flexibility in forming and implementing intentions. State orientation is thus characterized by indecisiveness and hesitation under demanding circumstances.

Action versus state orientation has emerged as a consistent moderator of the relationship between intentions and behavior (for reviews, see Diefendorff et al., 2000; Koole, Jostmann, & Baumann, 2012; Kuhl & Beckmann, 1994). Indeed, behavioral differences between action- versus state-oriented people are apparent in important life domains such as health, sports, education and work. For example, state orientation predicts lower execution of demanding health-behaviors, such as participation in exercise programs (Kendzierski, 1990) and maintaining a healthy diet (Palfai, 2002). Furthermore, among Dutch high school students, state orientation is associated with poorer reading comprehension and lower math scores (Boekaerts & Otten, 1993). In work settings, state-oriented employees receive lower evaluations on job performance by their supervisors than action-oriented employees (Diefendorff et al., 2000; Diefendorff, Richard & Gosserand, 2006).

More controlled laboratory studies have shown that action orientation predicts performance on effortful cognitive tasks, especially under demanding circumstances. For example, after visualizing a demanding other, state-oriented people display lower performance on working memory tasks than action-oriented people (Jostmann & Koole, 2006). Other research has examined the Stroop task (Stroop, 1935; see MacLeod, 1991), in which participants have to name word colors while ignoring the words' meaning. Because reading is more automatic than color naming, color naming gets harder when colors are incongruent with word meanings (e.g. the word red displayed in a blue font). Under demanding conditions, people who are state-oriented were found to display more Stroop interference than their action-oriented counterparts (Jostmann & Koole, 2007). Finally, state-oriented people display weaker memory for to-be-enacted tasks under demanding conditions than action-oriented people (Kazén, Kaschel & Kuhl, 2008).

Although the behavioral effects of action versus state orientation are robust, they do not emerge at all times. Specifically, the self-regulatory difficulties of state-oriented people are much reduced under less demanding conditions. For instance,

in the aforementioned studies on working memory (Jostmann & Koole, 2006) and Stroop performance (Jostmann & Koole, 2007), state-oriented people performed significantly better under low-demanding conditions, such as after visualizing an accepting person or in the absence of working memory load. In a related vein, two recent experiments observed that state-oriented people became significantly better at enacting difficult intentions in a Stroop task when they were asked to relax rather than to fully exert themselves (Ruigendijk & Koole, 2014). By contrast, among action-oriented people, relaxation led to worse Stroop performance than full exertion.

At first glance, it seems paradoxical that state-oriented people would perform difficult tasks more effectively when they are relaxing rather than exerting themselves. However, we suspect that relaxation may not so much lead state-oriented people to withhold all their effort, but rather may guide them towards exerting a different kind of effort. More specifically, relaxation may lead state-oriented people to shift from proactive control towards reactive control. During reactive control, people rely more on cues from the environment to determine their course of action. Thus, if state-oriented people rely more on reactive control, they may be expected to benefit more from external cues than action-oriented people. Consistent with this, Kazén et al. (2008) found that providing helpful pre-cues led to a greater speed-up in action initiation times among state-oriented people than among their action-oriented counterparts. Thus, there is initial evidence that pre-cues may be particularly beneficial to state-oriented people, consistent with their presumed reliance on reactive control.

| Congruency Sequence Effects

Within cognitive psychology, reactive control processes have been extensively studied in cognitive interference tasks (for a recent overview, see Hengstler, Holland, van Steenbergen, & van Knippenberg, 2014). Cognitive interference tasks, like the Eriksen (Eriksen & Eriksen, 1974) flanker task and the Stroop (1935) task consist of a number of trials, some of which involve a conflict between incongruent responses. A frequent finding is that, after people have encountered one incongruent trial, response times to a subsequent conflict trial become significantly reduced (Gratton et al., 1992). The latter effect has become known under various names, such as the Gratton effect (Gratton et al., 1992), or the conflict adaptation effect (e.g., Mayr, Awh & Laurey, 2003). In the present article, we prefer the term 'congruency sequence effects' (Egner, 2007) because it is descriptive and theoretically neutral.

The theoretical interpretation of congruency sequence effects has been the matter of some debate (for a review, see Duthoo, Abrahamse, Braem, Boehler, & Notebaert, 2014). According to some authors, congruency sequence effects are due to low-level

cognitive processes, such as feature integration (e.g. Mayr et al., 2003; Hommel, 2004) or contingency learning (Mordkoff, 2012; Schmidt & De Houwer, 2011). However, other studies have shown, that even if low-level cognitive processes may occur, congruency sequence effects are also due to dynamic shifts in cognitive control or "conflict adaptation" processes (Botvinick, Braver, Barch, Carter, & Cohen, 2001; Duthoo & Notebaert, 2012; Puccioni & Vallesi, 2012; Hengstler, et al., 2014). From the conflict adaptation perspective, people are presumably equipped with a neural system (which may be located in the anterior cingulate cortex) that monitors information processing for the occurrence of conflicts, which indicate the need for increased control. Once conflict is detected, the monitoring system signals to higher-order control systems (which may be located in the dorsolateral prefrontal cortex) that cognitive control efforts should be increased. Consistent with this model, congruency sequence effects occur even in the absence of feature repetition and contingency learning confounds (Duthoo & Notebaert, 2012; Puccioni & Vallesi, 2012; Schmidt & Weissman, 2014; Weissman, Jiang, & Egner, 2014). Moreover, data from neurophysiological studies have provided converging support for conflict adaptation (Egner, 2007).

Notably, both reactive and proactive processes may play a role in the congruency sequence effect (Egner, Ely, & Grinband, 2010; Duthoo, Wühr, & Notebaert, 2013). When response-stimulus intervals (RSIs) and inter-stimulus intervals (ISIs) are long, people have ample time to respond. In such cases, proactive control processes have more time to emerge and are determined by the level of conflict in the previous trial. However, when response-stimulus RSIs and ISIs are short (RSIs between 500 up to 2000 ms and ISIs up to 3000 ms), people have little time to respond. In the latter cases, proactive control processes do not have time to emerge, and transient reactive control is automatically triggered by the level of conflict in the previous trial. The speeded variants of the conflict adaptation paradigm thus seem most suited for studying reactive control processes among action- versus state-oriented people

The link between congruency sequence effects and reactive control has important implications for our understanding of action- versus state-oriented people. To the extent that congruency sequence effects are reflective of reactive control, state-oriented individuals can be expected to display more pronounced congruency sequence effects than action-oriented individuals. Moreover, relaxing conditions can be expected to evoke stronger reactive control processes among state-oriented individuals than among action-oriented individuals.

| The Present Research and Hypotheses

In the present research, we empirically examined whether and how action versus state orientation may moderate congruency sequence effects in the Stroop task. Previous research suggests that action-oriented individuals generally rely on proactive control, while state-oriented individuals rely on reactive control (Baumann & Kuhl, 2005; Diefendorff et al., 2006; Jostmann & Koole, 2007). Congruency sequence effects are generally presumed to be driven by reactive control processes (Botvinick et al., 2001), especially when people have little time to come up with more sophisticated response strategies (Duthoo et al., 2014). Combining these notions, we reasoned that state-oriented participants would display stronger congruency sequence effects, while action-oriented participants would be less prone to display such effects.

In a recent study, we found evidence that relaxing, rather than exerting maximal effort promotes cognitive control among state-oriented people (Ruigendijk & Koole, 2014, Study 4). We therefore expected that congruency sequence effects would emerge more readily among state-oriented people when they were relaxed rather than focused on their task intention. To test this notion, we included a manipulation of intention focus in the present studies (see Ruigendijk & Koole, 2014; Smilek, Enns, Eastwood, & Merikle, 2006). Half of the participants were told to explicitly focus on their intention during the Stroop task, the other half of the participants were told to relax and to rely on their spontaneous responses. Relaxed conditions should stimulate reactive control among state-oriented people. We therefore expected that state-oriented individuals would display stronger congruency sequence effects under relaxed conditions than under intention focus conditions. Finally, we expected that action-oriented people would generally rely less on reactive control. We therefore predicted that action-oriented people would not display congruency sequence effects regardless of intention focus.

| Study 4.1

In Study 4.1, we examined the effects of action versus state orientation and intention focus in a relatively conventional Stroop task (Notebaert, Gevers, Verbruggen, & Liefooghe, 2006). It should be noted, however, that our version of the Stroop task had a high proportion of incongruent trials (66%). This renders the task less demanding, because participants are often reminded of the goal to name the word colors (Kane & Engle, 2003). We chose this version of the Stroop task to leave more room for reactive control processes to emerge among state-oriented participants. Because of the high proportion of incongruent trials, we did not expect effects of action-state orientation

on the overall Stroop effect (see also Jostmann & Koole, 2007, Study 4.1) . Thus, our predictions regarding the effects of action-state orientation and intention focus in Study 4.1 were specific to congruency sequence effects in the Stroop task.

| Method

Participants and Design

Participants were 57 students at the VU University Amsterdam (30 female and 27 male, average age 22) who participated for study credits or money. Participants with varying action versus state orientation were randomly assigned to the weak intention focus versus strong intention focus conditions. The main dependent variable was performance during the Stroop color-naming task, with congruency on the current trial (current congruency: congruent vs. incongruent) and congruency on the previous trial (previous congruency: congruent vs. incongruent) as within-participants variables.

Materials and Procedure

Participants received all instructions via the computer in individual cubicles. They were informed that they participated in several unrelated studies from different researchers. Participants first filled out some personality questionnaires, which included the Action Control Scale (ACS90; Kuhl & Beckmann, 1994). Next, participants completed a Stroop color-naming task. After this, participants completed a test for color-blindness by detecting numbers between patterns of dots and answered some biographical questions. Finally, participants were debriefed, thanked, and rewarded for their participation.

Action orientation. Individual differences in action versus state orientation were assessed with a Dutch translation of the 12-item decisiveness subscale of the ACS-90 (Kuhl, 1994). This scale has been validated extensively in over 80 studies (for reviews, see Koole et al., 2012; Kuhl & Beckmann, 1994; Diefendorff et al., 2000). An illustrative item is, 'When I have to take care of something important which is also unpleasant: a) I do it and get it over with, b) It can take a while before I can bring myself to it'. In this case, answer *a* is scored as action-oriented and answer *b* is scored as state-oriented. Reliability of the scale was sufficient, Cronbach's alpha = .78. Individuals scores ranged from 1 to 12, and the median response was 6 over both conditions, 6 in the weak intention focus condition and 5 in the strong intention focus condition.

Stroop task. The Stroop task was adapted from Notebaert et al. (2006). Participants were presented with color words and were told to ignore the meaning of the words and to respond to the color of the letters. Participants were instructed to respond as

quickly and accurately as possible. Participants practiced with 27 trials on which they received feedback and then completed four runs of 90 experimental trials. Congruent stimuli were the words RED, BLUE or GREEN presented in the matching ink colors, the letters that formed the word were approximately 1.3 cm high and 1 cm wide. Incongruent stimuli were the same words presented in mismatching colors; this resulted in 9 different stimuli. Order of presentation of the stimuli, of which 33% were congruent and 66% incongruent trials, was varied randomly for each participant.

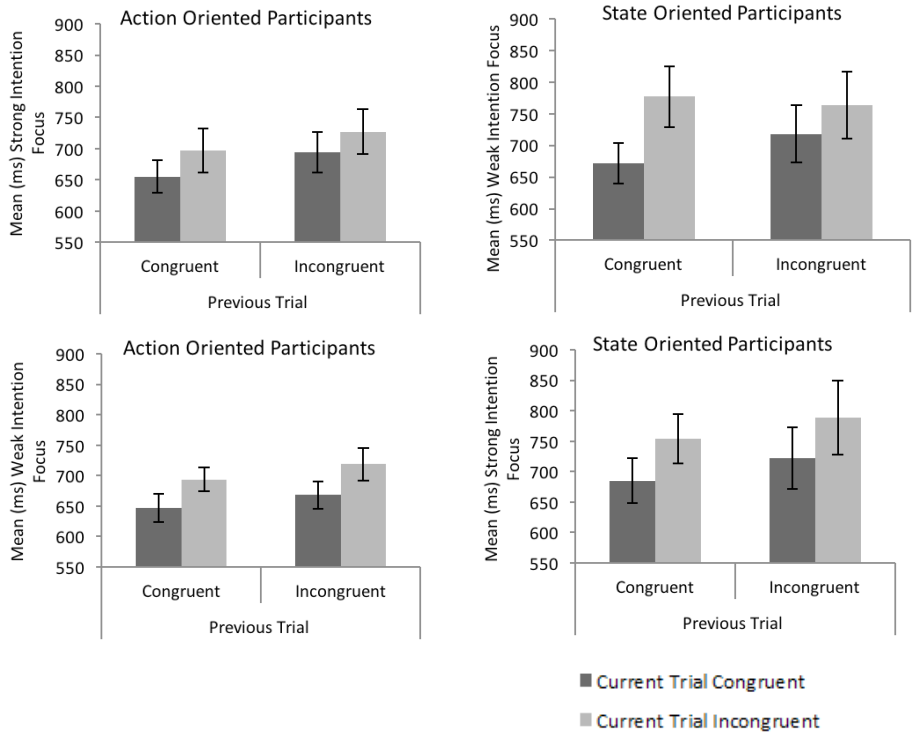
Each trial started with a fixation cross that was presented for 200 milliseconds in the center of the screen, which was immediately followed by the presentation of a word. The word remained on the screen until the participants responded. Participants were to respond to each trial by pressing the "j", "k" or "l" key of the keyboard with, respectively, their index, middle and ring finger to indicate the color of the word.

There were three different kinds of sequences of trials: First, both word color and word meaning could change so that a trial was a complete alternation of the previous trial. There were four types of these complete alternations: congruent-congruent (CC), incongruent-congruent (IC), congruent-incongruent (CI) and incongruent-incongruent (II) sequences. Second, word color could change but not word meaning or vice versa, so that a trial was a partial repetition of the previous trial (this is possible for IC, CI and II sequences). Third and last, word color and word meaning could both stay the same, so that a trial was a complete repetition of the previous trial (CC and II sequences). The last two sequences confound conflict adaptation and repetition effects (Mayr et al., 2003). Therefore, we analyzed only complete alternations and excluded partial and complete repetition trials from analysis.

Intention Focus Manipulation. During the Stroop task, the instructions were experimentally varied (for the exact wording, see Ruigendijk & Koole, 2014). In the weak intention focus condition, participants were informed that the best strategy to perform the task was to relax and let the right answer 'pop' into their minds. Participants were asked to let their intuition, together with what they saw on the screen, determine their responses. By contrast, in the strong intention focus condition, participants were informed that the best strategy for this task was to be as active as possible and to consciously direct their attention to determine their response. The order and sentence structure of the intention focus manipulation were carefully matched between conditions.

Figure 4.1.

Response times (RTs) for congruent and incongruent trials (only complete alternations) as a function of the congruency of the previous trial (n – 1) among action- versus state-oriented participants under weak and strong intention focus. The upper panels show RTs for action-oriented participants, the lower panels for state-oriented participants.



Results

We excluded every first trial from a block, as well as errors and trials following errors (4% of all responses). RTs shorter than 150 and longer than 2,000 milliseconds were excluded (1.8% of all trials). We analyzed only trials in which both the color and the word of the previous and current trial alternated. We did not analyze complete and partial repetitions because responses during the latter trials are susceptible to response priming and thus provide an impure measure of conflict adaptation.

To analyze the data, we categorized participants as either action- or state-oriented on the basis of a median split. We chose for this method because it allows for inspection of the absolute mean RTs in the Stroop task, as is common in the conflict adaptation literature (e.g. Notebaert et al., 2006) and which would not be possible by plotting the

regression results (see Figure 4.1). The statistical significance of our predicted effects did not change when we treated action versus state orientation scores as a continuous variable[1].

Table 4.1.

Mean Response Times in Milliseconds (Standard Deviation) for Congruent (C) and Incongruent (I) trials for action-oriented participants (AO) and state-oriented participants (SO) over all conditions (General), in the Strong Intention Focus Condition (Strong), the Weak Intention Focus Condition (Weak) and in the Control Condition (Study 4.1)

		General		Action		State	
		C *M (SD)*	I *M (SD)*	C *M (SD)*	I *M (SD)*	C *M (SD)*	I *M (SD)*
Study 4.1	General	682 (121)	739 (147)	666 (94)	709 (109)	699 (146)	771 (95)
	Weak	676 (115)	737 (142)	658 (83)	706 (85)	695 (141)	771 (182)
	Strong	688 (130)	740 (155)	675 (106)	712 (131)	704 (156)	772 (178)
Study 4.2	General	721 (128)	773 (149)	729 (126)	778 (139)	712 (131)	768 (159)
	Weak	686 (102)	738 (120)	702 (93)	735 (101)	667 (112)	741 (141)
	Strong	755 (141)	818 (157)	734 (138)	826 (161)	769 (147)	812 (161)
	Control	725 (135)	769 (161)	751 (147)	786 (152)	696 (119)	749 (174)

Note. The difference between congruent and incongruent trials (Stroop effect) was significant at the $p < .05$ level in all conditions, for action-oriented as well as state-oriented participants.

Overall Stroop Effect. There was a general Stroop effect, such that participants responded slower to incongruent than to congruent trials (M_{diff} = 57 ms, SD = 59) $F(1, 55) = 57.24$, $p < .001$, $\eta_p^2 = .51$. There was also a marginal main effect of orientation, with state-oriented participants showing a larger Stroop effect (M_{diff}= 72 ms, SD = 64) than action-oriented participants (M_{diff} = 43 ms, SD = 51), $F(1, 55) = 3.50$, $p = .07$, $\eta_p^2 = .06$. In absolute terms, the Stroop effect was statistically significant both for state-oriented participants, $F(1, 55)= 42.29$, $p < .001$, $\eta_p^2 = .44$, and for action-oriented participants $F(1, 55) = 17.12$, $p < .001$, $\eta_p^2 = .24$. An analysis of variance (ANOVA) with two between factors (action orientation and intention focus) and one within factor (current congruency) revealed that the interaction between orientation, intention focus and the Stroop effect was not significant, $F < 0.01$, $p > .92$. Relevant means are displayed in Table 4.1. At first glance, the lack of effects may seem at

1. In Studies 4.1 and 4.2, we also conducted the same analyses with scores on the action versus state orientation scale as a continuous variable. In Study 4.1, the interaction effect of previous congruency, current congruency and orientation in the weak intention focus condition remained significant, $F(1,27) = 4.42$, $p = .05$, $\eta p^2 = .14$. In Study 4.2, the five-way interaction effect of intention focus condition, precue, previous congruency, current congruency and orientation also remained significant, $F(2,68) = 3.27$, $p = .04$, $\eta p^2 = .09$. Thus, our main findings were not altered when we treated action versus state orientation as a continuous variable. We report the analyses with the dichotomized scale because this allows readers to inspect the absolute means of our design.

odds with Ruigendijk and Koole (2014, Study 4.1) . However, the latter study had 75% congruent trials, so that responding to the incongruent trials required more proactive control than in the present Study 4.1, which had only 33% congruent trials. Theoretically, effects of action-state orientation should only occur on overall Stroop effects when the task makes high demands on proactive control.

Congruency Sequence Effects. An analysis of variance (ANOVA) with two between factors (action orientation and intention focus) and two within factors (congruency on the current trial n, and congruency on trial n-1) revealed that the interaction of current congruency, previous congruency, focus, and orientation was not significant, $F(1,53) = 1.70$, $p = .20$. However, an omnibus interaction test can be insensitive, especially when the predicted pattern of effects does not cross over in the different conditions (Rosnow & Rosenthal, 1995). We therefore proceeded by analyzing the results separately for strong and weak intention focus conditions.

Weak Intention Focus. In the weak intention focus condition, there was a general Stroop effect: Participants were slower to respond during incongruent trials than during congruent trials $M_{diff} = 61, SD = 57), F(1,27) = 34.96, p < .001, \eta_p^2 = .56$. Additionally, there was a general trend for the congruency sequence effect, $F(1, 27) = 3.19$, $p = .09$, $\eta_p^2 = .11$, with a larger Stroop effect after congruent trials, $F(1, 27) = 28.95$, $p < .001$, $\eta_p^2 = 0.52$, ($M_{diff} = 75$ ms, $SD = 80$) than after incongruent trials $F(1, 27) = 16.21$, $p < .001$, $\eta_p^2 = 0.38$, ($M_{diff} = 48$ ms, $SD = 63$). The interaction between action versus state orientation and current congruency was not significant, $F(1, 26) = 1.63$, $p = .21$, $\eta_p^2 = .06$, observed power 23%. More importantly, however, we found the predicted three-way interaction effect of current congruency, previous congruency, and orientation, $F(1, 27) = 4.11$, $p = .05$, $\eta_p^2 = .13$. Relevant means are displayed in Figure 4.1.

Table 4.2.

Mean Response Time in Milliseconds (Standard Deviation) for Congruent and Incongruent Trials as a Function of Action Orientation (AO) versus State Orientation (SO) and Previous Trial Type in the Strong Intention Focus Condition and the Weak Intention Focus Condition (Study 4.1)

		Previous Congruent		Previous Incongruent	
		Current Congruent *M (SD)*	Current Incongruent *M (SD)*	Current Congruent *M (SD)*	Current Incongruent *M (SD)*
Weak Focus	State-oriented	672 (120)	777 (181)	718 (179)	764 (189)**
	Action-oriented	647 (90)	694 (73)	668 (88)	719 (106)
Strong Focus	State-oriented	685 (135)	754 (149)	722 (183)	789 (219)
	Action-oriented	655 (101)	697 (135)	694 (124)	727 (141)

Note. The congruency sequence effect is significant with ** $p = .01$

Consistent with the congruency sequence effect, state-oriented participants in the weak intention focus condition showed a larger Stroop effect after congruent trials, $F(1, 27) = 26{,}82$, $p < .001$, $\eta_p^2 = .50$, ($M_{diff} = 105$ ms, $SD = 85$) than after incongruent trials, $F(1, 27) = 7.06$, $p = .01$, $\eta_p^2 = .21$ ($M_{diff} = 46$ ms, $SD = 72$), $F(1, 27) = 7.02$, $p = .01$, $\eta_p^2 = .21$ (all means are displayed in table 4.2), as well as a general Stroop effect $F(1, 27) = 24.98$, $p < .001$, $\eta_p^2 = .48$ ($M_{diff} = 75$ ms, SD = 73), but no main effect of previous trial, $F = 1.44$, $p = .24$.

By contrast, action-oriented participants in the weak intention focus condition did not show a congruency sequence effect, $F < 1$. Specifically, the Stroop effect for action-oriented participants was similar after congruent trials, $F(1, 27) = 5.68$, $p = .02$, $\eta_p^2 = .17$, ($M_{diff} = 47$ ms, $SD = 61$) and incongruent trials, $F(1, 27) = 9.26$, $p = .01$, $\eta_p^2 = .26$ ($M_{diff} = 51$ ms). For action-oriented participants, there was even a marginal trend in the opposite direction as a conflict adaptation effect, such that action-oriented participants responded more slowly after incongruent than after congruent trials ($M_{diff} = 23$ ms, SD = 41), $F(1, 27) = 2.99$, $p = .10$, $\eta_p^2 = .10$. Finally, action-oriented participants also displayed a general Stroop effect ($M_{diff} = 49$ ms, $SD = 35$) $F(1, 27) = 11.13$, $p = .002$, $\eta_p^2 = .29$ (see Figure 4.1).

Strong Intention Focus. In the strong intention focus condition, there was a general Stroop effect, $F(1, 26) = 21.67$, $p < .001$, $\eta_p^2 = .46$, such that participants were slower during incongruent trials than during congruent trials ($M_{diff} = 52$, $SD = 61$). No interactions of current congruency and previous congruency were found, $F = .07$, $p = .80$, nor an interaction of current congruency, previous congruency and orientation, $F = .01$, $p = .91$. The interaction between action versus state orientation and current congruency was not significant, $F(1, 26) = 1.72$, $p = .20$, $\eta_p^2 = .06$. Finally, the Stroop effect was significant for state-oriented participants $F(1, 26) = 16.61$, $p < .001$, $\eta_p^2 = .39$ ($M_{diff} = 68$ ms, $SD = 54$) as well as action-oriented participants $F(1, 26) = 6.02$, $p = .02$, $\eta_p^2 = .19$ ($M_{diff} = 38$ ms, $SD = 64$).

Discussion

Study 4.1 tested the idea that action versus state orientation moderates congruency sequence effects in the Stroop task. Unexpectedly, the overall interaction effect with the intention focus manipulation was not statistically significant. Nevertheless, separate analyses by each intention focus condition did reveal the expected pattern. The only reliable congruency sequence effects emerged among state-oriented participants in the weak intention focus condition. This is consistent with the idea that state-oriented people rely on more reactive forms of cognitive control when they weakly focus on their intentions (Ruigendijk & Koole, 2014). The results of Study 4.1 did not support the hypothesis that reactive control processes lead to improved

cognitive control among state-oriented people; Stroop interference did not differ significantly between the strong and weak intention focus conditions.

There were no congruency sequence effects among action-oriented participants. However, action-oriented participants had a marginally smaller Stroop effect than state-oriented participants. It thus appears that action-oriented participants were quite effective at resolving Stroop interference, without relying on reactive control processes. This pattern supports the interpretation that action-oriented people are rather efficient at proactive control (Ruigendijk & Koole, 2014).

Study 4.2

In Study 4.2, we used a different version of the Stroop task, one that varied whether participants were exposed to visual pre-cues that made the Stroop task either easier or harder. Specifically, previous work has shown that large visual pre-cues decrease the salience of word meaning and therefore result in weaker Stroop effects, whereas small visual pre-cues increase the salience of word meaning and therefore result in stronger Stroop effects (Chen, 2003). Therefore, in the current study we manipulated the size of the precue to be either large or small. According to our reasoning, when visual attention is manipulated through a large pre-cue, people may reactively rely on the environment to adjust their visual attention for them.

Prior work has shown that state-oriented people display improved action control when they are aided by pre-cues (Kazén et al., 2008), presumably because pre-cues facilitate reactive control. Any congruency sequence effects among state-oriented should therefore be especially pronounced when helpful pre-cues are available. This effect of pre-cues was not predicted for action-oriented people, because proactive control does not rely on pre-cues. Therefore, we expected that state-oriented participants would show more conflict adaptation effects in the weak intention focus condition when they were aided by a large pre-cue, which enabled them to rely on even more reactive bottom up control. We also expected that large pre-cues would generally reduce the Stroop effect among state-oriented participants. For action-oriented participants, we did not expect any effects of pre-cues and focus condition on either the Stroop or conflict adaptation effect, because we expected them to rely more on proactive control processes.

The pre-cues reduced the overall demands of the Stroop task on proactive control. Action-state orientation is only a reliable predictor of the Stroop effect when the task makes high demands on proactive control (Jostmann & Koole, 2007; Ruigendijk & Koole, 2014). We therefore did not predict effects of action-state orientation on the overall Stroop effect.

| Method

Participants and Design

Participants were 74 students of the VU University Amsterdam (48 female and 26 male, average age 21) who participated in return for either credits or money. Participants with varying in action versus orientation were randomly assigned to the weak intention focus versus strong intention focus versus control conditions. The main dependent variable was performance during the Stroop color-naming task, with congruency on trial n (congruent vs. incongruent), congruency on trial n-1 (congruent vs. incongruent) and pre-cue size (small vs. large) as within-participants variables.

Materials and Procedure

The materials and procedure were similar to Study 4.1, except for three differences. A first difference was that participants rated their moods prior to filling out the ACS90 (Kuhl & Beckmann, 1994; Cronbach's alpha of the demand-related subscale = .72, individual scores ranging from 0 to 12, median over all conditions = 5, median weak intention focus condition = 6, median strong intention focus condition = 4, median control condition = 5). Specifically, participants were asked to rate their current mood on a validated questionnaire developed by Kuhl (1997). The mood measure consisted of 23 adjectives that were rated on a 4-point Likert scale (from 1 = not at all, to 4 = very much). Illustrative items are "How aggressive do you feel?" and "How sad do you feel?" (Cronbach's alpha = .89). Statistically controlling for mood as a covariate did not change the effects of orientation and intention focus on Stroop performance or conflict adaptation.

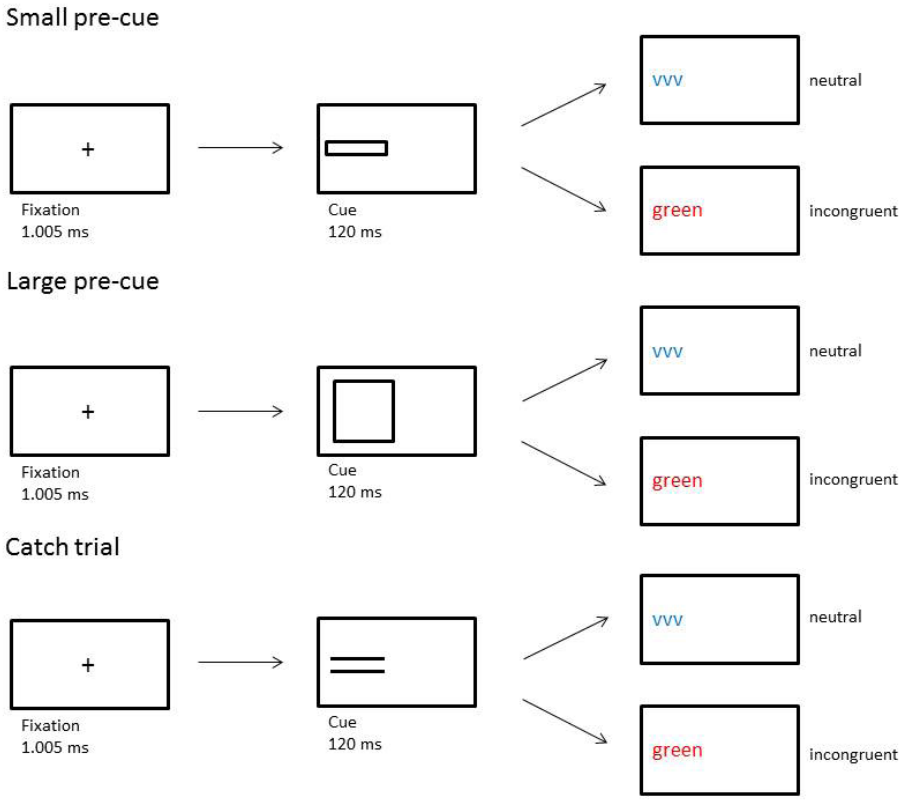
A second difference was that we added an experimental condition in which intention focus was not manipulated. We included this additional control condition to see if the effects of action versus state orientation were specific to conditions of weak intention focus, or whether they perhaps generalized to any condition under which the task intentions were not especially salient.

Third and last, participants received a different version of the Stroop task that was based on Chen (2003, Study 4) . As in Study 4.1, participants were presented with color words and were asked to ignore the meaning of the words and to respond as quickly and accurately as possible to the color of the letters. There were two important differences with the Stroop task in Study 4.1. First, participants were exposed to a neutral/low conflict environment in which only 33% of the trials were high conflict trials (i.e., incongruent). This low conflict environment is more demanding, because it requires more proactive control. We chose this version of the task because we wanted to avoid the task was too easy for the pre-cues to have an effect (i.e., to avoid floor effects). Second, each trial was preceded by a pre-cue that was either large or

small. Participants practiced with 27 trials on which they received feedback and then completed two blocks of 216 trials each, one run with large and one with small cues.

Figure 4.2

A schematic representation of the Stroop task in study 4.2



Congruent stimuli were the words RED, BLUE, GREEN or YELLOW presented in congruent font colors. The letters that formed the words were approximately 1.3 cm high and 1 cm wide. Incongruent stimuli were identical, except that they were presented in incongruent font colors. In each block, participants responded to 144 color words, of which 96 were target trials and 48 were catch trials. The other 72 words were neutral (VVVV, TTTTT, MMMMM and PPPPPP), of which 48 were target trials and 24 were catch trials. In the large pre-cue block, target pre-cues were large rectangles that covered 66% of the screen's height (approximately 15 cm) and 41% of the screen's width (approximately 11 cm) in one run. In the small pre-cue block, pre-

cues were small rectangles that covered 14% of the screen's height (approximately 3 cm) and 41% of the screen's width. Catch trial pre-cues in both blocks consisted of a pair of horizontally aligned bars, made from the corresponding rectangle by removing its vertical bars. Figure 4.2 provides a schematic representation of the task. Each trial started with a fixation cross, presented for 1,005 milliseconds in the center of the screen, which was immediately followed by the pre-cue, which was presented for 120 milliseconds. After the pre-cue, the Stroop word was presented for 120 milliseconds. Participants were to respond to each trial by pressing the corresponding color label that was fixed to the "q", "w", "o" or "p" keys of the keyboard. Participants were instructed to use their index and middle fingers of both hands to indicate the color of the word when target trials were presented. Following a catch trial pre-cue, participants were to respond by pressing the space bar when the Stroop stimulus appeared. These catch trial pre-cues were used to test whether participants indeed processed the pre-cues as they were supposed to.

| Results

The average false alarm rate was 8% during the catch trials, indicating that participants processed the pre-cues. Therefore, our manipulation of visual pre-cues was successful. We excluded every first trial from a block, as well as errors and trials following errors (5%). RTs shorter than 150 and longer than 2,000 milliseconds were excluded (1.6 % of the remaining trials). We only analyzed trials in which the color and the word of the previous trial completely alternated with color and word of the current trial. We excluded complete and partial repetitions from analysis because they were susceptible to response priming. To enable comparison with Study 4.1, we analyzed only congruent and incongruent target trials.

Overall Stroop Effect. In line with the Stroop effect, participants were generally slower to respond to colors that were incongruent rather than congruent with the word names (M_{diff} = 52, SD = 72), $F(1,68) = 42.70$, $p < .001$, $\eta_p^2 = .39$. No interaction between orientation and the Stroop effect was found, $F(1, 68) = 0.03$, $p = .86$. In absolute terms, action-oriented participants showed a Stroop effect, (Mdiff = 49, SD = 68), $F(1,72) = 16.31$, $p < .001$, $\eta_p^2 = .19$, that was similar in size to the Stroop effect of state-oriented participants, (Mdiff = 56, SD = 76), $F(1,72) = 22.72$, $p < .001$, $\eta_p^2 = .24$. An analysis of variance (ANOVA) with two between factors (action orientation and intention focus) and two within factors (pre-cue and current congruency) revealed no interaction between orientation, focus, pre-cue and congruency, $F = 0.93$, $p = 40$. Presumably, providing visual precues reduced the proactive aspect of the Stroop task, which is particularly relevant for individual differences in action versus state orientation (Jostmann & Koole, 2007; Ruigendijk & Koole, 2014).

Congruency Sequence Effects. Next, we conducted a mixed-model ANOVA with two between factors (action orientation and intention focus) and three within factors (pre-cues, congruency on the current trial n, and congruency on trial n-1). This analysis yielded the predicted five-way interaction between orientation, focus condition, pre-cue, previous congruency and current congruency was significant, $F(2, 68) = 4.01$, $p = .02$, $\eta_p^2 = .11$[1]. To interpret this interaction, we proceeded by analyzing the data separately by intention focus condition.

Weak Intention Focus. In the weak intention focus condition, participants were generally slower to respond to colors that were incongruent rather than congruent with the word names ($M_{diff} = 52$ ms, $SD = 86$), $F(1, 23) = 9.72$, $p = .01$, $\eta_p^2 = .30$. The latter effect was in line with the Stroop effect. There was no effect of orientation on the Stroop effect, $F = 1.44$, $p = .24$. There was further a significant four-way interaction between orientation, congruency on trial n, congruency on trial n - 1, and pre-cue, $F(1, 23) = 9.35$, $p = .01$, $\eta_p^2 = .29$. We next analyzed the results separately for action- and state-oriented participants in the weak intention focus condition. All relevant means are displayed in table 4.3.

Table 4.3.

Mean Response Time in Milliseconds (Standard Deviation) for Congruent (C) and Incongruent (I) Trials as a Function of Orientation, Pre-cue and Previous Trial Type in the Weak Focus Condition (Study 4.2)

		Previous Congruent		Previous Incongruent	
		Current Congruent *M (SD)*	Current Incongruent *M (SD)*	Current Congruent *M (SD)*	Current Incongruent *M (SD)*
Large Pre-cue	Action-oriented	698 (108)	731 (125)	701 (139)	743 (113)
	State-oriented	647 (103)	747 (129)	731 (131)	711 (148)**
Small Pre-cue	Action-oriented	669 (94)	724 (90)	742 (140)	742 (144)
	State-oriented	660 (140)	742 (146)	633 (127)	765 (200)

Note. The conflict adaptation effect is significant with ** $p = .01$

Among state-oriented participants, there was an interaction effect of pre-cue, congruency and previous trial, $F(1, 23) = 9.50$, $p = .01$, $\eta_p^2 = .29$. Follow-up tests showed a significant congruency sequence effect in the large pre-cue condition, $F(1, 23) = 7.31$, $p = .01$, $\eta_p^2 = .24$. In line with the congruency sequence effect, in the large pre-cue condition, state-oriented participants showed a Stroop effect after congruent trials ($M_{diff} = 100$ ms, $SD = 113$), $F(1, 23) = 8.62$, $p = .01$, $d_z = 0.27$, but not after incongruent trials ($M_{diff} = 19$ ms, $SD = 105$), $F = 0.36$, $p = .55$ (see Figure 4.3). There was no conflict adaptation effect among state-oriented participants in the small pre-cue condition, $F = 1.34$, $p = .26$. The interaction between pre-cue and current congruency

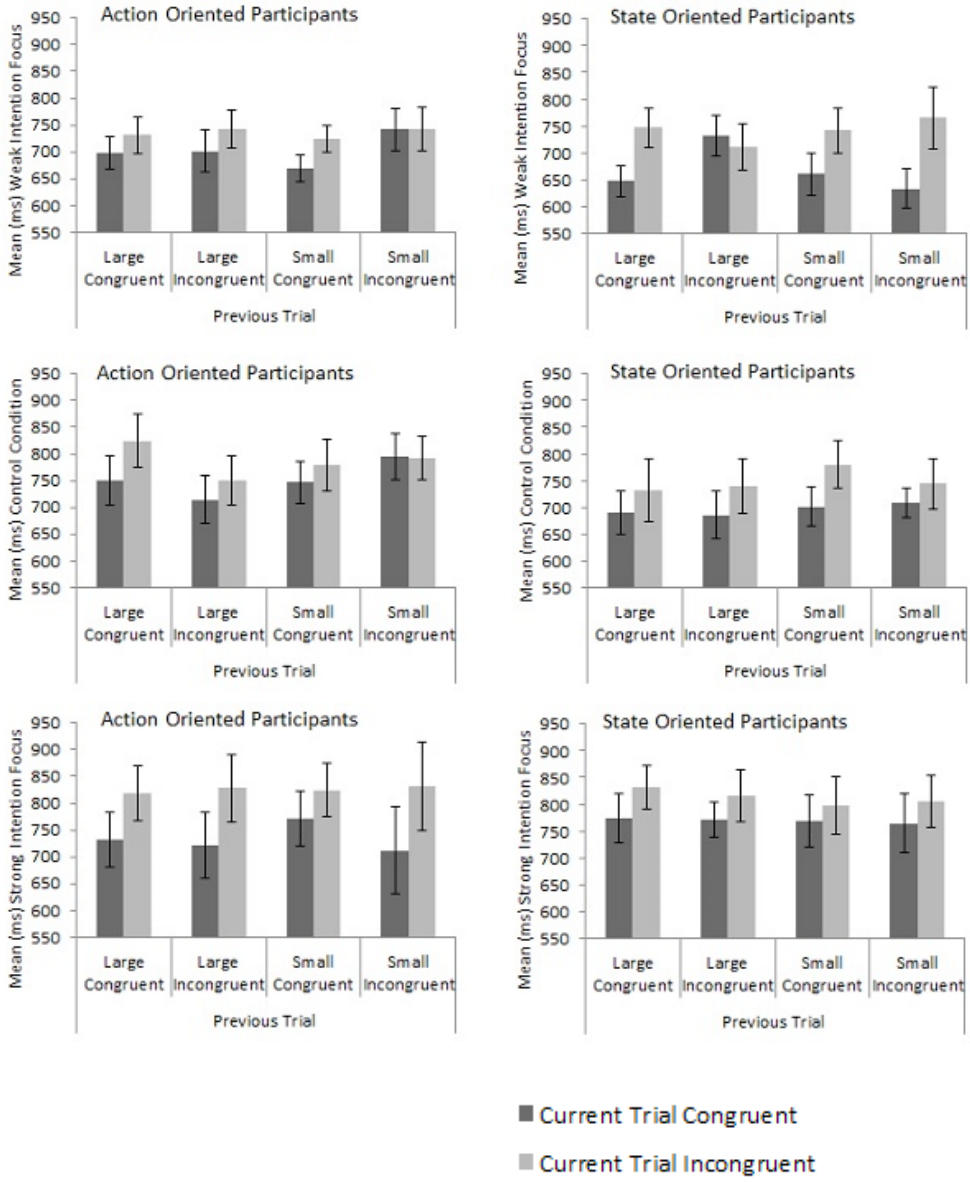
was also significant, $F(1, 23) = 5.51$, $p = .03$, $\eta_p^2 = .19$. This interaction was due to the fact that state-oriented participants had a larger and statistically significant Stroop effect in the small pre-cue condition (M_{diff} = 107 ms, SD = 110), $F(1, 27) = 11.62$, $p = .002$, $\eta_p^2 = 0.34$, than in the large pre-cue condition, where the Stroop effect was no longer statistically reliable, $F = 2.59$, $p = .12$ (M_{diff} = 40 ms, $SD = 84$).

Among action-oriented participants, there was no interaction of pre-cue, congruency and previous trial, $F = 1.45$, $p = .24$ (see Figure 4.3). Also, there were no Stroop effects regardless of pre-cue: $F = 0.05$, $p = .82$ for large pre-cues and $F = 1.67$, $p = .21$ for small pre-cues. In fact, action-oriented participants displayed a non-significantly larger Stroop effect in the condition with larger pre-cues (M_{diff} = 38 ms, $SD = 89$), than in the condition with small pre-cues (M_{diff} = 27 ms, $SD = 107$). No other effects were significant, all Fs < 2.1, ps > .17.

Strong Intention Focus. In the strong intention focus condition, there was an overall Stroop effect, $F(1, 20) = 26.38$, $p < .001$, $\eta_p^2 = .57$ ($M_{diff} = 63$, $SD = 64$). There was a trend effect of orientation on the Stroop effect, $F(1, 20) = 3.46$, $p = .08$, $\eta_p^2 = .15$. Unexpectedly, action-oriented participants showed a somewhat larger Stroop effect than state-oriented participants (respectively, $F(1, 20) = 20{,}71$, $p < .001$, $\eta_p^2 = .51$; M_{diff} = 92, $SD = 72$, versus $F(1, 20) = 6.56$, $p = .02$, $\eta_p^2 = .25$; M_{diff} = 43, SD = 51). No congruency sequence effects or any other effects were found, all Fs < .95, all ps >.34.

Control Condition. The only significant effect was an overall Stroop effect, $F(1, 25)$ = 12.17, p= .002, $\eta_p^2 = .33$, with participants responding slower to incongruent than to congruent trials (M_{diff} = 44, $SD = 65$). Although state-oriented participants showed a directionally larger Stroop effect than action-oriented participants, (respectively, $F(1, 25) = 8{,}32$, $p = .01$, $\eta_p^2 = .25$; M_{diff}= 52, $SD = 87$ versus $F(1, 25) = 4.14$, $p = .053$, $\eta_p^2 = .14$; M_{diff}= 36, $SD = 36$) the effect of orientation on the Stroop effect was not significant, $F(1, 25) = 0.44$, p = .51. No congruency sequence effects or any other effects were found, all Fs < 2.23, ps < .15.

Figure 4.3. Response times (RTs) in the weak intention focus condition, control condition and strong intention focus condition for congruent and incongruent trials with a large and small pre-cues as a function of the congruency of the previous trial (n – 1), only for complete alternation sequences. The upper panels shows RTs for action-oriented participants, the lower panels for state-oriented participants (Study 4.2).



| Discussion

The results of Study 4.2 further support the idea that action versus state orientation moderates congruency sequence effects in the Stroop task. Indeed, the predicted interaction between orientation and intention focus was statistically significant in Study 4.2. As expected, we found evidence for congruency sequence effects in the weak intention focus condition with the large pre-cues, but not in any other condition. In line with our theoretical predictions, congruency sequence effects appeared among state-oriented participants, who showed a reliable conflict adaptation effect in the large pre-cue condition when they were weakly focused on the task intention. By contrast, action-oriented participants did not show congruency sequence effects in any of the experimental conditions.

Study 4.2 thus confirms our hypothesis that state-oriented people rely more on reactive control than action-oriented people. Moreover, Study 4.2 demonstrates that state-oriented peoples' reliance on reactive control processes provide a performance advantage when helpful pre-cues are available. Indeed, the Stroop effect even disappeared in the weak intention focus condition with large pre-cues among state-oriented participants. By contrast action-oriented participants showed none of these effects, suggesting these individuals relied very little, if at all, on reactive control.

Unexpectedly, there were no differences in the overall Stroop effect between action- and state-oriented participants. Indeed, action-oriented participants even had a marginally larger Stroop effect than state-oriented participants in the strong intention focus condition. The latter finding seems to be at odds with previous studies, in which action-oriented people displayed better cognitive control than state-oriented individuals under conditions of strong intention focus (Ruigendijk & Koole, 2014). We suspect that providing visual pre-cues facilitated reactive control processes in the Stroop task in Study 4.2. If this is correct, the visual pre-cues may have prevented the mobilization of proactive control among action-oriented people. Further research is needed to test this line of reasoning.

| General Discussion

In the present research, we investigated the joint effects of action versus state orientation and intention focus on congruency sequence effects in the Stroop task. Based on the notion that state-oriented people rely more on reactive control than action-oriented people, we hypothesized that state-oriented people would display stronger congruency sequence effects than action-oriented people, especially under conditions of weak intention focus. The results of two experiments supported this hypothesis: State-oriented

participants showed reliable congruency sequence effects, but only when they were weakly (rather than strongly) focused on the task intention (Studies 4.1 and 4.2) and when helpful pre-cues were available (Study 4.2). Action-oriented participants, on the other hand, showed no congruency sequence effects, irrespective of intention focus or pre-cueing.

Previous work showed that state-oriented individuals are capable of executing difficult actions in supportive or relaxed contexts that presumably facilitate reactive control (Jostmann & Koole, 2006, 2007; Kazén et al., 2008; Ruigendijk & Koole, 2014). The present studies confirm this pattern and extend it to a more basic level of trial-by-trial dynamics in action control as they are occurring in a Stroop task. We suggest that, under relaxed circumstances and when pre-cues are available, state-oriented individuals are able to rely on reactive forms of control, and that this is reflected in greater congruency sequence effects. The absence of congruency sequence effects among action-oriented participants in any of the conditions, suggests that action-oriented individuals are inclined to rely much less on such reactive forms of action control.

Unlike previous research (e.g. Gratton et al., 1992; Botvinick et al., 2001; Ullsperger et al., 2005) we did not find a general congruency sequence effect in our studies. In each of the present studies, the overall congruency sequence effect was in the expected direction, but did not reach statistical significance, $F(1, 56) = 1.56$, $p = .22$ (Study 4.1), and $F(1,73) = 1.33$, $p = .25$ (Study 4.2). It could be that our intention focus manipulation and the provision of pre-cues somehow dampened the overall congruency sequence effect. It is noteworthy, however, that congruency sequence effects have emerged somewhat inconsistently in the cognitive literature. Although the effect has been replicated many times (e.g., Botvinick et al., 2001; Ullsperger et al., 2005), some studies have failed to find the effect (Mayr et al., 2003; Schmidt & De Houwer, 2011). The latter studies did not include measures of action versus state orientation. It is thus conceivable that individual differences in action versus state orientation contributed to variability in congruency sequence effects in the prior literature. Future studies in this area may benefit from a consideration of this individual difference variable.

Like all scientific research, the present work is not without limitations, and thus leaves important issues open for future inquiry. One limitation is that we designed the present Stroop paradigms to be maximally informative about reactive control processes. As a result, the present findings do not speak to the more proactive forms of control that are used by action-oriented people (see Ruigendijk & Koole, 2014). In future work, it would be useful to obtain simultaneous measures of both proactive and reactive control. If the present analysis is correct, then state-oriented people should display a distinctive profile of high reactive control and low proactive control, whereas action-oriented people should display the opposite profile of low reactive control and high proactive control.

A second limitation is that the present studies focused only on the demand-related facet of action versus state orientation. Because the construct of action versus state orientation is multidimensional (Diefendorff et al., 2000; Kuhl, 1994; Papantoniou, Moraitou, Katsadima, & Dinou, 2010), it remains important to investigate the link between other facets of action versus state orientation and congruence sequence effects. Notably, a recent study observed that the threat-related facet of action orientation (AOT) was a positive predictor of congruency sequence effects in the Stroop task (Fischer, Plessow, Dreisbach, & Goschke 2014). These preliminary findings suggest that there may also be a proactive component in congruency sequence effects, in addition to the reactive component that was the focus of the present studies Theoretically, it may be that incongruent trials in the Stroop may evoke perceptions of implicit threat (Proulx, Inzlicht, & Harmon-Jones, 2012), which are monitored and down-regulated more rapidly by people who are action-oriented on the AOT facet (see Koole & Van den Berg, 2005). This proactive perceptual process may contribute to congruency sequence effects over and above the more reactive behavioral process that was the focus of the present studies. However, in the current studies we did not find a positive correlation between (see Footnote 2). Consequently, more research is needed to clarify the relation between congruence sequence effects and the different facets of action versus state orientation.

A third limitation is that the sample size of the present studies was small, which could be why some of the predicted effects were not or only marginally statistically significant. In recent years, there has been a growing realization among behavioral scientists that larger samples are needed to attain adequate statistical power (Schimmack, 2012). It would therefore be desirable to replicate the present studies with larger samples (see also Koole & Lakens, 2012, on the importance of direct replications).

Despite these caveats, the present findings could have important implications for the everyday functioning of state-oriented people. In general, state-oriented people experience difficulties with action control in demanding situations (for a review, see Koole et al., 2012). The current research shows, however, that to optimize their performance, state-oriented people can benefit from reactive control processes, especially in a relaxed atmosphere. In everyday life, state-oriented people may capitalize on this beneficial effect by seeking out relaxed contexts (e.g., supportive colleagues) and by making sure that the environment provides them with reliable prompts whenever state-oriented people have to perform a difficult task. A supportive environment may thus help state-oriented people to make the most of themselves.

2. We also measured AOT in the present studies, and found that AOT was non-significantly positively correlated with congruency sequence effects in Study 4.1, r (57)= ..07, p = .63, whereas AOT was non-significantly negatively correlated with congruency sequence effects in Study 4.2, r (74)= -.17, p = .15.

4

CHAPTER 5

An Exploratory Study on the Neural Architecture of Action Control: Dissociated Brain Networks for Individual Differences in Decisiveness and Disengagement

An Exploratory Study on the Neural Architecture of Action Control: Dissociated Brain Networks for Individual Differences in Decisiveness and Disengagement

People must frequently deal with aversive events during their goal pursuits, such as unexpected setbacks, negative feedback and time pressure. According to action control theory (Kuhl, 1984, 1994), people vary in their ability to regulate their actions under such challenging conditions. When people are action-oriented, they are capable of initiating new courses of action under demanding conditions and of disengaging their mind from negative emotional states. When people are state-oriented, they are more prone to lack initiative and to become preoccupied with negative emotion.

Although action versus state orientation may vary from moment to moment, there are also chronic individual differences in whether people are generally more action- or more state-oriented (Kuhl, 1994). In the previous chapters of this dissertation, we have focused only on the demand-related facet of action versus state orientation. However, action control theory distinguishes between two main facets of global action versus state orientation. The demand-related facet of action orientation, relates to the person's ability to form, maintain, and implement intentions, particularly in demanding situations. Individual differences in this facet range from decisiveness to hesitation in enacting one's intentions. For the sake of brevity, we refer to individual differences in demand-related action orientation as "decisiveness". The threat-related facet of action versus state orientation relates to the person's ability to mentally disengage from negative events. Individual differences in this facet range from flexible disengagement to preoccupation with negative events. For the sake of brevity, we refer to individual differences in threat-related action orientation as "disengagement". For an overview of the effects of decisiveness and disengagement on emotional, cognitive and behavioral self-regulation see Table 5.1 (for reviews, see Diefendorff, Hall, Lord, Strean, 2000; Kuhl & Beckmann, 1994).

Despite the extensive behavioral research on the construct of action versus state orientation, little is known about its neural foundations. In one of the few relevant studies, Rosahl, Tennigkeit, Kuhl, & Haschke, (1993) observed that individual differences in action versus state orientation were associated with differences in event-related slow potential shifts in response to emotionally charged words. These initial findings elucidate the relation between action versus state orientation and patterns of functional brain activity. As a relatively stable personality disposition, however, action versus state orientation may also be related to structural parameters of the brain. In the present study, we sought to learn more about this latter issue.

Table 5.1

Differences in behavioral, emotional and cognitive self-regulation that are predicted by higher compared to lower individual levels of decisiveness and disengagement

	Decisiveness	Relevant studies	Disengagement	Relevant Studies
Definition	Individual differences in self-regulation under demanding circumstances, ranging from decisiveness to indecision		Individual differences in self-regulation under threatening circumstances, ranging from cognitive disengagement to preoccupation	
Behavior	More self-initiated enactment of difficult intentions in controlled laboratory tasks in work settings in education settings in health settings	Kazén, et al, 2008 Diefendorff et al., 2000 Diefendorff, 2004 Palfai, 2002, Palfai et al. 2002	Less learned helplessness Less conformity More consistent behavioral preferences	Kuhl, 1981 Beckmann, 1994 Guevara, 1994
Emotion	Efficient up-regulation of positive affect More mood regulation More implicit affect regulation Physiological regulation	Baumann et al., 2007 Koole & Jostmann, 2004 Koole & Fockenberg., 2011 Heckhausen & Strang, 1988	Efficient down-regulation of negative affect Lower use of pain killers, faster recovery after surgery More efficient suppression of existential threats	Baumann et al., 2007 Kuhl, 1982 Koole & van den Berg, 2005
Cognition	More efficient working memory More attention control More parsimonious decision-making	Jostmann & Koole, 2006 Jostmann & Koole, 2007 Kuhl & Beckmann, 1983	Less mind-wandering during a cognitive task Better memory for emotional preferences More accurate intuitive coherence judgments	Baumann & Kuhl, 2003 Kuhl & Kazén, 1994 Baumann & Kuhl, 2002

Specifically, the present study investigated how individual differences in decisiveness and disengagement are related to the volume and concentration of gray matter and the direction and density of white matter tracts. Gray matter consists of the brain tissue that contains neural cell bodies and is an elementary component of the brain that processes and structures sensory and cognitive information. Individual differences in gray matter that are related to action orientation therefore reflect differences in information processing that are more structural and long-lasting than the transient influence of the environment or a temporary state of mind. White matter primarily consists of myelinated axon bundles that connect gray matter areas and enable messages to travel between these areas. Individual differences in white matter that are related to action orientation therefore reflect structural differences in communication between different brain areas. Because the present exploratory study is the first to investigate the structural brain correlates of action versus state orientation, we did not focus our analyses on specific regions of interest. Instead, we explored how gray and white matter in the whole brain are correlated with individual differences in action versus state orientation. In prior studies, individual differences

in personality traits have been related to structural variance in specific brain regions (e.g. Kaasinen, Maguire, Kurki, Bruck, & Rinne, 2005; Gardini, Cloninger, & Venneri, 2009; Pujol et al., 2002 and Matsui et al., 2002). Because decisiveness and disengagement are both trait-like constructs, we hypothesized that individual differences in decisiveness and disengagement would be reflected in differences in the underlying neural structures that mediate these traits.

The separability of decisiveness and disengagement was a second important focus of the present study. Prior research has yielded somewhat conflicting findings with regard to the association between decisiveness and disengagement. In several studies, decisiveness and disengagement have emerged as separate psychometric dimensions (Diefendorff et al., 2000; Kuhl, 1994; Papantoniou, Moraitou, Dinou, & Katsadima, 2010) and were found to have differential behavioral correlates (e.g., Baumann, Kaschel, & Kuhl, 2005; Koole, 2004). However, in other studies, correlations between decisiveness and disengagement in the .40s and higher were observed (e.g., Blunt & Pychyl, 1998; Frese, Fay, Hilburger, Leng, & Tag, 1997; Rholes, Michas, & Shroff, 1989). Indeed, several studies aggregated decisiveness and disengagement values into a single score, presumably because similar patterns of behavioral correlates were found for the two constructs (e.g., Blunt & Pychyl, 2005; Rholes et al., 1989). The latter studies raise the question whether decisiveness and disengagement might be considered one and the same.

Because decisiveness and disengagement are conceptually distinct (Kuhl & Beckmann, 1994), we expected to find neural correlates that are uniquely related to individual differences in either decisiveness or in disengagement. More generally, individual differences in decisiveness and disengagement both relate to cognitive, behavioural, and emotional self-regulation. Therefore, we simultaneously expect that individual differences in decisiveness as well as in disengagement correlate independently with the same structural differences in the brain.

Finally, with the present study we sought to establish if the neural correlates of individual differences in decisiveness and disengagement are independent of the Five Factor Model personality dimensions, i.e., extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience (McCrae & Costa, 1987). Kuhl (2000) has suggested that these traditional personality traits do not capture individual differences in action versus state orientation. In line with this notion, action versus state orientation has been found to predict behavior over and above the Big Five dimensions (Diefendorff et al., 2000). On the basis of these considerations, we expected that any neural correlations of individual differences decisiveness and disengagement would not be explained by the Five Factor Model personality dimensions.

| Method

Participants

Ninety-six participants with no reported history of neurological or psychiatric diseases were included (67 women; average age 22.7). Participants were recruited by means of sign-up sheets to which mostly, but not exclusively, students of psychology replied. All participants signed informed consent and the experiment was approved by the ethical committee of the 'University of Amsterdam' and in accordance with APA Ethics Code guidelines. The participants took part in a larger program of research on personality and brain structure.

Procedure

Participants completed the Action Control Scale (ACS-90; Kuhl, 1994) and the revised NEO personality inventory (NEO-PI-R; Costa & McCrae, 1992) via a web-based survey. Magnetic resonance images were acquired using a 3 Tesla Intera scanner (Philips). We acquired two three dimensional (3D) T1 weighted scans per particpants that were used to determine gray matter (3D T1, Turbo Field Echo, echo time (TE) 4.6 ms, repetition time (TR) 9.6 ms, flip angle (FA) 8°, 182 sagittal slices of 1.2 mm, field of view (FOV) 250^2 mm, reconstruction matrix 256^2 mm). We acquired two diffusion-weighted MRI (DWI) sequences that were used to calculate fractional anisotropy (DWI spin-echo (SE) echo planar imaging (EPI), TR 8958 ms, TE 60 ms, FA 90°, FOV 224^2 mm, matrix size $112^{2\ mm}$, 70 slices, slice thickness 2 mm, degree of diffusion sensitivity (b0) = 1000 s/mm^2, 32 directions, 2 repeats).

ACS-90 and NEO-PI-R questionnaires

Individual differences in action versus state orientation were assessed with the ACS-90, a well-validated measure of this construct (Kuhl, 1994; Diefendorff et al., 2000). Our measurement included two 12-item subscales of the ACS-90, which measured individual differences in a) decisiveness versus hesitation, and b) disengagement versus preoccupation. An illustrative item of the decisiveness scale is, 'When I have to take care of something important which is also unpleasant: a) I do it and get it over with, b) It can take a while before I can bring myself to it'. In this case, answer *a* is scored as action-oriented and answer *b* is scored as state-oriented on the decisiveness facet. An illustrative item of the disengagement scale is: 'When I have lost something that is very valuable to me and I can't find it anywhere: a) I have a hard time concentrating on something else, b) I put it out of my mind after a little while.' For this item answer *a* is scored as state-oriented and answer *b* is scored as action-oriented on the disengagement facet.

We used the NEO-PI-R (Costa & McCrae, 1992) to assess the Five Factor Model personality dimensions. This instrument consists of 24 Likert questions for each dimension (neuroticism, extraversion, agreeableness, openness and conscientiousness), resulting in a total of 120 items.

Data-Analytic Strategy

Voxel-Based Morphometry.

To determine gray matter throughout the brain, we used voxel-based morphometry (VBM; Good et al., 2001). VBM is a technique that can be used for making inferences about individual differences in gray matter at a voxel level. We analyzed the first T1 3D scans of each participant, utilizing FSL (FMRIB Software Library; Smith et al., 2004). First, structural brain images were extracted (Smith, 2002) and subsequently aligned and averaged. Next, tissue-type segmentation was carried out using FAST4 (FMRIB's Automated Segmentation Tool v4; Zhang, Brady, & Smith, 2001). The resulting gray-matter partial volume images were then aligned to MNI152 (Montreal Neurological Institute 152) standard space using the affine registration. The resulting images were averaged to create a study-specific template, to which the native gray matter images were then non-linearly re-registered with a method based on a b-spline representation of the registration warp field (Rueckert et al., 1999, Andersson, Jenkinson, & Smith, 2007). To correct for local expansion or contraction, the registered partial volume images were modulated by dividing by the Jacobian of the warp field. The modulated segmented images were then smoothed with an isotropic Gaussian kernel with a sigma of 4 mm. Finally, a voxelwise GLM (general linear model) was applied using permutation-based non-parametric testing.

We subsequently defined decisiveness and disengagement scores as explanatory variables (EVs) in a single model and calculated positive and negative contrasts from these EVs. In this way, we searched for areas that correlated positively and negatively with individual differences in decisiveness and disengagement. Next, we thresholded the resulting significance maps with a threshold of 200 connected voxels with a p-value lower than .01 to create regions of interest (ROIs). Then we preprocessed the second T1 3D scans of each participantin the same way as the first. We used the created ROIs to read out the VBM values, per participant, per ROI, of this second T1 3D scan. By using a second T1 3D scan for each person we avoided that the selection of ROIs and the VBM values were both affected by identical measurement noise.

Diffusion Tensor Imaging.

We calculated fractional anisotropy (FA), which reflects the degree of diffusion anisotropy within a voxel, on the basis of the acquisition of the DWI-SE-EPI measurements. The degree of diffusion anisotropy in a voxel is determined by micro structural features of the tissue in that particular voxel, including fiber properties (e.g., fiber diameter and density) and fiber

tract coherence. The start of each series of directions was preceded by an acquisition of a non-diffusion weighted volume. Data analysis and preprocessing was performed with FSL. Correction for eddy currents and small head movement was accomplished by means of affine registration on a reference volume using FLIRT (FMRIB's Linear Image Registration Tool).

DTI images were registered to the structural images via a single-shot SE EPI. FA was calculated for each voxel with FDT (FMRIB's diffusion toolbox). A larger FA value indicates a distortion of Brownian motion, which signifies the presence of coherent white matter tracts. Values closer to 0 correspond to more isotropic diffusion of water molecules (showing Brownian motion), and absence or little coherence of white matter. Voxelwise statistical analysis of the FA data was carried out using TBSS (Tract-Based Spatial Statistics, part of FSL). FA images were brain-extracted using BET (Brain Extraction Tool, part of FSL) and subsequently aligned onto a standard brain using FNIRT (FMRIB's Non-linear Image Registration Tool). The mean FA image is then created and thinned to generate a mean FA skeleton which represents the centers of all tracts common to the group. Each participant's aligned FA data is then projected onto this skeleton. The same predictors and contrasts as used for VBM were subsequently tested.

Next, we thresholded the resulting significance maps with a threshold of 150 connected voxels with a *p*-value lower than 0.05 to create ROIs. Then the second dataset was preprocessed in the same way as the first. We used the created ROIs to read out the FA values, per participant, per ROI, of this second dataset. Then we analyzed the second dataset in the same way as the first. Thus, we could determine the correlation of the corresponding voxels in the second dataset with decisiveness and disengagement independently of ROI selection.

Results

Cluster sizes, centers of gravity and Brodmann areas for regions that emerged from the analyses are displayed in Table 5.2. Figures 5.1-5.4 visualize the relevant brain areas that were associated with decisiveness and disengagement. Correlations between decisiveness, disengagement and the Five Factor Model personality dimensions are displayed in Table 5.3. Gray and white matter correlations with decisiveness and disengagement remained essentially the same when we controlled for scores on each dimension of the NEO-PI-R (see Tables 5.4 and 5.5).

Table 5.2

Regions of interest correlated with individual differences in decisiveness and disengagement

		Centre			AOD		AOT		
Brain region	**BA**	**x**	**y**	**z**	***r***	***p***	***r***	***p***	**size**
Right lingual gyrus	36	20	-46	-12	**.20**	**.05**	.08	.44	148
Bilateral precuneus	7	-4	-62	32	**.29**	**.00**	.03	.76	101
Right middle frontal gyrus	8	46	15	44	**.33**	**.00**	.11	.30	210
Bilateral caudate and accumbens	25AC	1	9	-3	**-.35**	**.00**	-.04	.74	815
Left inferior temporal gyrus	20/37	-44	-35	-19	**-.34**	**.00**	-.05	.66	185
Bilateral lingual gyrus	30	-3	-56	2	**-.23**	**.01**	.03	.80	198
Left superior temporal gyrus	22	-51	-38	2	**-.25**	**.02**	.05	.60	173
Right postcentral gyrus	5	7	-44	71	**-.30**	**.00**	-.14	.18	112
Hippocampus, white matter		23	-44	2	**.36**	**.00**	.03	.79	149
Corpus callosum, white matter		-1	20	17	**.24**	**.02**	.11	.30	102
Left cerebellum, Crus I		-29	-84	-27	-.03	.80	**.19**	**.06**	221
Left premotor cortex	6	-19	4	67	.08	.44	**.25**	**.01**	217
Right temporal fusiform gyrus	20	32	-42	-16	.10	.32	**.28**	**.00**	172
Left temporal fusiform gyrus	37	-38	-48	-16	.04	.74	**.38**	**.00**	428
Left lingual gyrus	19	-18	-44	-4	-.10	.32	**-.26**	**.01**	104
Left occipital pole/intracalcarine cortex	17	-9	-90	3	.13	.20	**-.34**	**.00**	375
Left superior lateral occipital cortex	19	-23	-87	29	.06	.58	**-.23**	**.02**	205

Note. The reported *r* is the correlation between the GMC values of the second structural run and scores on the AOD subscale. Brain regions are reported based on the Harvard-Oxford Cortical Structural Atlas. Correlations with a *p*-value < .05 are in boldface. Unless otherwise indicated, gray matter areas are specified.

Table 5.3

Correlations of decisiveness and disengagement with the Five Factor Model personality dimensions

	Decisiveness		Disengagement	
	r	***p***	***r***	***p***
Neuroticism	**.21**	**.04**	.10	.32
Extraversion	.05	.61	-.04	.72
Openness	-.03	.81	.03	.76
Agreeableness	.15	.15	-.02	.87
Conscientiousness	-.16	.11	-.10	.33

Correlations with a p-value < .05 are in boldface.

Gray Matter

Decisiveness scores were positively associated with gray matter volume in the precuneus ($r(94) = .29$, $p = .00$), middle frontal gyrus ($r(94) = .33$, $p = .00$) and lingual gyrus ($r(94) = .20$, $p = .05$). Decisiveness scores were negatively associated with gray matter volume in the caudatus and accumbens ($r(94) = -.35$, $p = .00$), the superior temporal gyrus ($r(94) = -.25$, $p = .02$) and the postcentral gyrus ($r(94) = -.30$, $p = .00$). The relevant brain structures are highlighted in Figure 5.1. None of the aforementioned regions of interest correlated significantly with disengagement. Decisiveness and disengagement did not correlate, $r(94) = .15$, $p = .14$.

Figure 5.1.

Gray matter areas correlated with decisiveness. Positive correlations are red, negative correlations blue. Left on the picture is left in the brain. STR, caudate/accumbens; MFG, middle frontal gyrus; STG, superior temporal gyrus; ITG, inferior temporal gyrus; PCG, postcentral gyrus; LG, lingual gyrus; PCU, Precuneus.

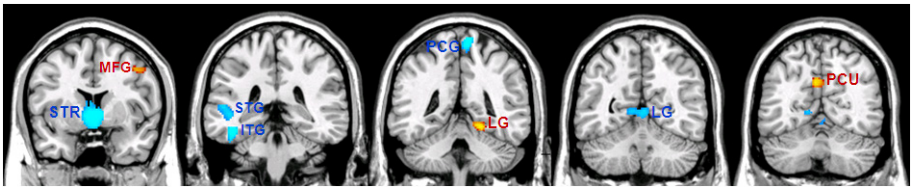
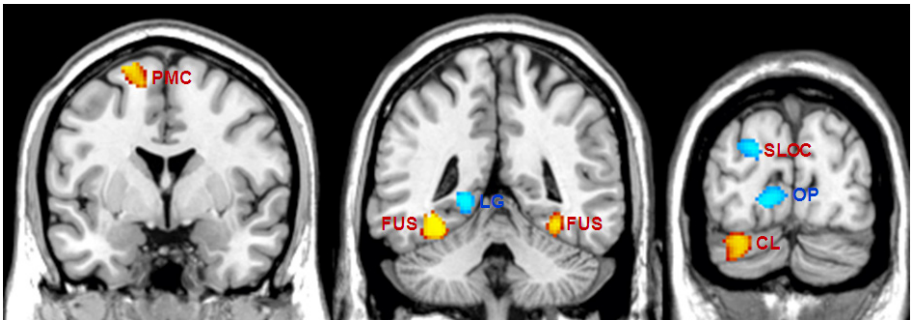


Figure 5.2.

Gray matter areas correlated with disengagement. Positive correlations are red, negative correlations blue. Left in the picture is left in the brain. PMC, premotor cortex; FUS, temporal fusiform gyrus; LG, lingual gyrus; CL cerebellum; SLOC, superior lateral occipital cortex; OP, occipital pole.



Disengagement scores were positively associated with gray matter volume in the premotor cortex ($r(94)$ =.25, p = .01) and the left ($r(94)$ = .38, p = .00) and right fusiform gyrus ($r(94)$ =.28, p = .00), and the left cerebellum ($r(94)$ =.19, p = .06), although this last finding was only marginally significant. Disengagement scores were negatively associated with gray matter volume in the lingual and cingulate gyrus ($r(94)$ =-.26, p = .01), the occipital pole ($r(94)$ =-.34, p = .00) and the superior lateral occipital cortex ($r(94)$ =-.23, p = .02). Relevant brain structures are highlighted in Figure 5.2. None of the aforementioned regions of interest correlated significantly with decisiveness.

White Matter

Decisiveness scores were positively associated with white matter density in one tract deriving from the hippocampus ($r(94)$ = .36, p = .00) and one tract in the corpus callosum ($r(94)$ =.24, p = .02), see Figure 5.3. None of the aforementioned regions of interest correlated significantly with disengagement. Throughout the brain, no white matter tracts correlated with disengagement.

Separability of decisiveness and disengagement

These results show distinct and non-overlapping correlations of decisiveness and disengagement with gray matter volume and white matter densities. Simultaneously, the scores on the decisiveness and disengagement scales were not significantly correlated, $r(94)$ = .15, p = .14. In other studies, however, decisiveness and disengagement were strongly correlated (e.g., Blunt & Pychyl, 1998, 2005; Rholes et al., 1989). The lack of correlation in our original sample could be a possible explanation for our findings that decisiveness and disengagement were related to distinct and non-overlapping structural differences. To further address this matter, we calculated the relationship of brain structures with differences in decisiveness and disengagement when the scales correlated at different levels. To this end, we permutated 20,000 subsamples that consisted of randomly drawn samples of 48 of the 96 participants. This resulted in a population of samples with correlations between decisiveness and disengagement ranging from -0.26 to 0.45 (see Figure 5.5).

Next, the 20,000 subsamples were divided into eight bins of 2,500 samples. The mean correlations between decisiveness and disengagement within these stratified bins are given in Table 5.6. After this, we randomly drew 2,500 combinations of each of the eight subsequent bins. For each of these combinations, we scored whether the correlation between two subsequent bins increased (coded as 1) or decreased (coded as -1). If the sum of these scores was larger than 0, this indicated a general increase in correlation between the brain region and decisiveness or disengagement as the correlation between both scales increased. If the sum of the scores was smaller than 0, this indicated a decrease in correlation between the brain region and decisiveness or

disengagement as the correlation between both scales increased. We will refer to these series as the test series. Furthermore, we sampled 2,500 combinations that were drawn in random order from the eight bins and performed the same analysis for each of these tests. We refer to these series as the noise series. Next, we analyzed whether each of these test-series deviated from the noise series with an unpaired t-test.

Figure 5.3.
A white matter tract deriving from the hippocampus correlated with decisiveness.

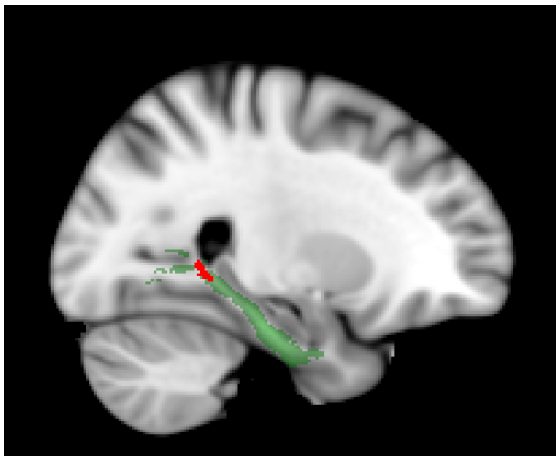
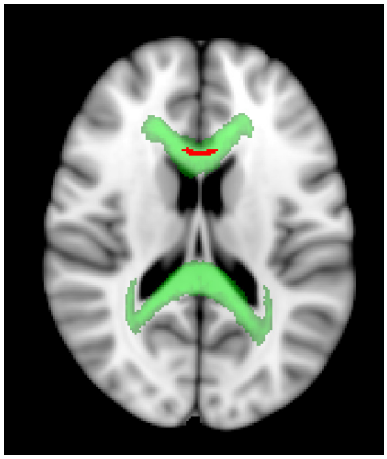


Figure 5.4.
A white matter tract in the corpus callosum correlated with decisiveness.



These analyses revealed three gray matter structures that correlated stably and uniquely with decisiveness as the correlation between subscales increased; the caudate, the superior temporal gyrus and the inferior temporal gyrus, and one white matter tract; the hippocampus (all Bonferroni corrected *p*-values > .05). The other gray matter correlates of decisiveness changed significantly as the relationship between decisiveness and disengagement changed. These correlates were the lingual gyrus, precuneus, middle frontal gyrus and the postcentral gyrus (all Bonferroni corrected *p*-values < .01). The white matter tract in the corpus callosum also changed significantly (*p*-value < .01). The relationship of these structures with decisiveness was influenced by the correlation between decisiveness and disengagement.

Table 5.4

Correlations of brain structures with decisiveness and these same structures controlled for the Five Factor Model personality dimensions

	AOD	AOD (N)	AOD (E)	AOD (O)	AOD (A)	AOD (C)
Brain region	***r (p)***	***r (p)***	***r (p)***	***r (p)***	***r (p)***	***r (p)***
Right lingual gyrus	.20 (.05)	.18 (.08)	.20 (.05)	.20 (.05)	.19 (.06)	.21 (.05)
Bilateral precuneus	.29 (.00)	.28 (.01)	.29 (.01)	.29 (.00)	.28 (.01)	.27 (.01)
Right middle frontal gyrus	.33 (.00)	.31 (.00)	.33 (.00)	.33 (.00)	.31 (.00)	.31 (.00)
Bilateral caudate and accumbens	-.35 (.00)	-.35 (.00)	-.35 (.00)	-.36 (.00)	-.35 (.00)	-.34 (.00)
Left inferior temporal gyrus	-.34 (.00)	-.33 (.00)	-.34 (.00)	-.34 (.00)	-.37 (.00)	-.32 (.00)
Bilateral lingual gyrus	-.23 (.01)	-.25 (.02)	-.23 (.03)	-.23 (.02)	-.23 (.02)	-.23 (.01)
Left superior temporal gyrus	-.25 (.02)	-.24 (.02)	-.25 (.01)	-.25 (.02)	-.27 (.01)	-.23 (.02)
Right postcentral gyrus	-.30 (.00)	-.30 (.00)	-.30 (.00)	-.31 (.00)	-.30 (.00)	-.30 (.00)

Table 5.5

Correlations of brain structures with disengagement and these same structures controlled for the Five Factor Model personality dimensions

	AOT	AOT (N)	AOT (E)	AOT (O)	AOT (A)	AOT (C)
Brain region	***r (p)***	***r (p)***	***r (p)***	***r (p)***	***r (p)***	***r (p)***
Left cerebellum, Crus I	.19 (.06)	.18 (.09)	.19 (.07)	.19 (.07)	.19 (.07)	.19 (.07)
Left premotor cortex	.25 (.01)	.25 (.01)	.25 (.02)	.25 (.01)	.25 (.02)	.24 (.02)
Right temporal fusiform gyrus	.28 (.00)	.27 (.01)	.28 (.01)	.28 (.01)	.28 (01)	.28 (.01)
Left temporal fusiform gyrus	.38 (.00)	.37 (.00)	.37 (.00)	.37 (.00)	.39 (.00)	.39 (.00)
Left lingual gyrus	-.26 (.01)	-.27 (.01)	.27 (.01)	-.26 (.02)	-.26 (.01)	-.25 (.01)
Left occipital pole	-.34 (.00)	-.35 (.00)	-.33 (.00)	-.34 (.00)	-.34 (.00)	-.35 (.00)
Left superior lateral occipital cortex	-.23 (.02)	-.25 (.02)	-.23 (.02)	-.25 (.02)	-.23 (.02)	-.24 (.02)

Table 5.6

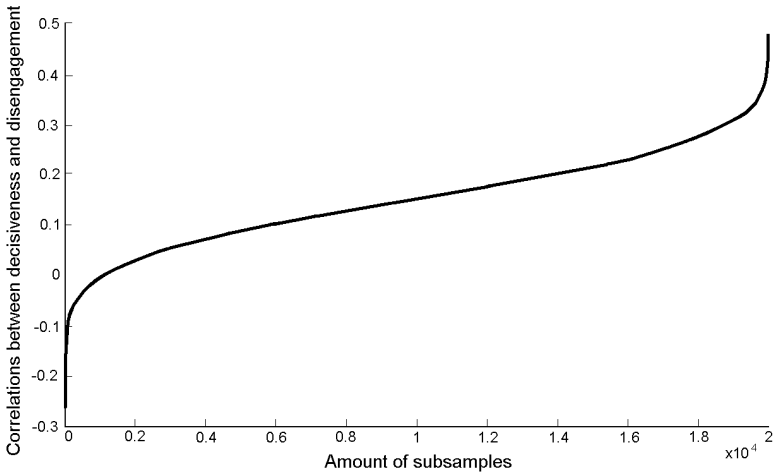
Correlations between decisiveness and disengagement for the eight different bins of subsamples

	Bin[a]							
	1	2	3	4	5	6	7	8
R	0	0,07	0,11	0,14	0,17	0,2	0,24	0,31

[a]n = 2500

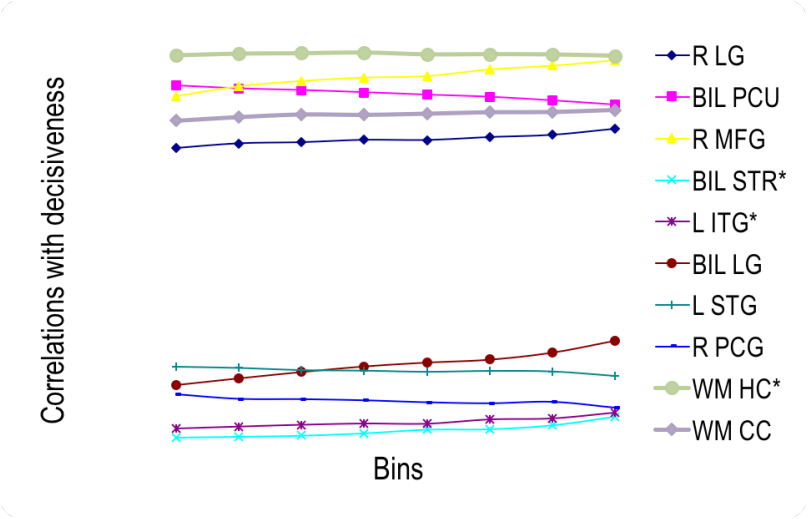
Figure 5.5.

Permutated differences in correlations between decisiveness and disengagement.



Disengagement correlated stably and uniquely with the cerebellum and the left fusiform temporal gyrus as the correlation between subscales increased (Bonferroni corrected *p*-values > .05). The other gray matter correlates of disengagement changed significantly as the relationship between decisiveness and disengagement changed. These correlates were the premotor cortex, right temporal fusiform gyrus, lingual gyrus, occipital cortex and lateral occipital cortex (all Bonferroni corrected *p*-values < .01). The relationship of these structures with disengagement was influenced by the correlation between decisiveness and disengagement. We did not find any brain areas that related to decisiveness as well as disengagement independently.

Figure 5.6.
Correlation of decisiveness with brain structure for the different bins. Each bin has a different correlation level for decisiveness and disengagement as depicted in Table 5.6. Correlations that show no significant change over bins are marked with * in the structure index. R, right; L, left; STR, caudate/accumbens; MFG, middle frontal gyrus; STG, superior temporal gyrus; ITG, inferior temporal gyrus; PCG, postcentral gyrus; LG, lingual gyrus; PCU, precuneus; WM, white matter; CC, corpus callosum; HC, hippocampus.



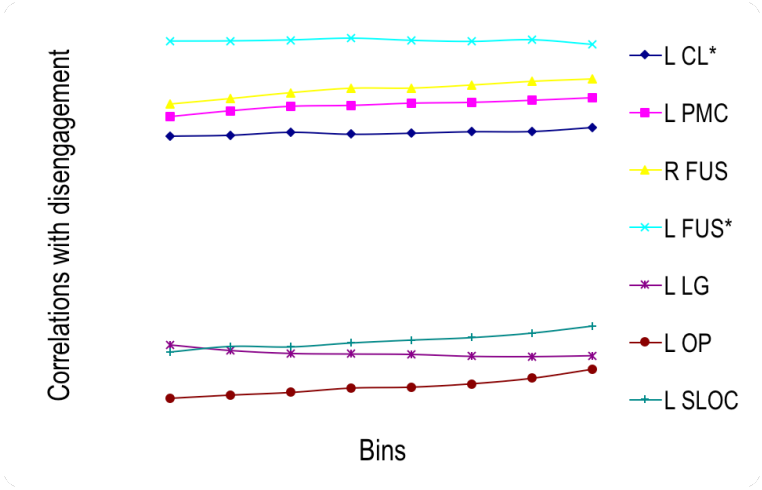
| Discussion

The present study shows that individual differences in decisiveness and disengagement are correlated with gray and white matter structures of the brain. We interpret this finding as in line with the relatively stable nature of the individual tendency towards action or state orientation. It is important to note, however, that the present findings do not mean that an individual's predominant orientation cannot change over time. Generally speaking, the structure of the brain is plastic and can change over time through practice, experience or stimulation (Luders, Toga, Lepore, & Gaser, 2009; Draganski et al., 2004, Draganski et al., 2006, May et al., 2007, Driemeyer, Boyke, Gaser, Buchel, & May, 2008 and Boyke, Driemeyer, Gaser, Buechel, & May, 2008). Indeed, prior work has found that decisiveness and disengagement can be changed through therapy (de Jong-Meyer et al., 1999; Hartung & Schulte, 1994) and increase with age (Gröpel, Kuhl, & Kazén, 2004). Thus, decisiveness and disengagement represent relatively stable, but changeable aspects of personality.

Individual differences in decisiveness and disengagement had distinct and non-overlapping correlations with differences in gray matter volume and white matter densities. A critic might argue that the reason for the brain areas showing no overlap is a lack of correlation between decisiveness and disengagement in the present sample. Therefore we conducted a complementary analysis on created bins in which individual differences in decisiveness and disengagement correlated at different levels. This analysis revealed that differences in the striatum, the superior temporal gyrus, inferior temporal gyrus and a white matter tract deriving from the hippocampus correlated uniquely with decisiveness. These correlations were not influenced by the relationship between decisiveness and disengagement (see Figure 5.6). Differences in the cerebellum and the left fusiform temporal gyrus were uniquely correlated with differences in disengagement and not influenced by the relationship between decisiveness and disengagement (see Figure 5.7). Taken together, the present study supports the conceptual distinction between decisiveness and disengagement, in that both constructs were correlated with a unique set of neural structures.

Figure 5.7.

Correlations of disengagement with brain structure for the different bins. Each bin has a different correlation level for decisiveness and disengagement as depicted in Table 5.6. Correlations that show no significant change over bins are marked with * in the structure index. R, right; L, left; CL cerebellum; PMC, premotor cortex; FUS, temporal fusiform gyrus; LG, lingual gyrus; OP, occipital pole; SLOC, superior lateral occipital cortex.



We did not find any shared structures that related to differences in decisiveness as well as disengagement. Nevertheless, correlations of individual differences in decisiveness and disengagement with several structures were influenced by the relationship between decisiveness and disengagement as shown by significant changes over bins (see Figures 5.6 and 5.7). This might indicate that differences in these structures are reflecting individual differences in a more general underlying system of action control. The present findings are consistent with factor-analytic and behavioural evidence that decisiveness and disengagement are separable, but mutually related aspects of volitional action control (Kuhl & Beckmann, 1994).

In the remainder of the discussion, we mainly focus on areas that uniquely correlated with differences in decisiveness and disengagement. Several findings are consistent with the literature on concepts that are theoretically related to action and state orientation. Specifically, differences in decisiveness correlated uniquely and positively with gray matter volume in the bilateral caudate nucleus and nucleus accumbens; two striatal structures. Earlier studies demonstrated that the striatum plays an important role in decision making, reward perception and outcome evaluation (Robbins & Everitt, 1992; for a review see Balleine, Delgado, & Hikosaka, 2007). For instance, increased activation levels in the striatum have been associated with facilitation of decision making under time-pressure (Forstmann et al., 2008). The correlation between differences in the caudate and accumbens and individual differences in decisiveness thus fits with behavioral evidence for a link between decisiveness and efficiency of decision-making under pressure (e.g., Kuhl & Beckmann, 1983; see Koole, Jostmann, & Baumann, 2012, for a review).

Another finding that is consistent with the existing literature is the unique and positive correlation of decisiveness with a white matter tract deriving from the hippocampus. The septo-hippocampal system has afferent and efferent connections to the caudate nucleus and nucleus accumbens (Raisman, Cowan, & Powel, 1966; Kelley & Domesick, 1982). Chronic high stress levels have been related to and might be the cause of reduced hippocampal volume (Woon, Sood, & Hedges, 2010) and atrophy of hippocampal dendrites (McEwen, 1999). Our results suggest that the latter effect may be more pronounced among state-oriented individuals, who are less capable of down-regulating stress than action-oriented individuals (Baumann, Kaschel, & Kuhl, 2007; Koole & Jostmann, 2004).

A finding that is consistent with literature on a concept closely tied to disengagement is the positive and unique correlation in Crus I of the cerebellum. Although the cerebellum itself was traditionally studied in the context of movement, its role in cognitive (Ito, 2008) and emotional processing (Ito, 2008; Schutter & van Honk, 2005; Schmahmann, 2004) is increasingly recognized. There is evidence that Crus I of the cerebellum has an important function in implicit or intuitive control of mental activities (Ito, 2005, 2006 & 2008). The correlation with Crus I indicates that the

ability to implicitly think could help to integrate new experiences into the existing self-system in a non-conscious manner. As a consequence involuntary attention to negative thoughts might be prevented. This finding thus suggests a new conception of disengagement as a consequence of an improved ability to process thoughts non-consciously. This explanation is in line with earlier findings that individuals high in disengagement are better at intuitive coherence judgments under stressful conditions relative to individuals low in disengagement (Baumann & Kuhl, 2002).

Notably, more than half of the observed correlates of individual differences in disengagement were located in areas that are associated with visual processing. These visual perception correlates point towards a role for visual processing in individual differences in disengagement. For disengagement, the ventral, as opposed to the dorsal, visual stream is theorized to be the dominant perception system (Kuhl & Koole, 2004; Kuhl, 2001). We found a negative correlate in the occipital pole (V1) or intracalcarine cortex. We also found positive correlations with the bilateral fusiform areas, but no correlates in parietal areas. This supports the theory that the ventral stream is the dominant perception system for disengagement. In an earlier study, individual differences in early visual processing were related to aberrant detail perception in autism spectrum disorder (Vandenbroucke, Scholte, van Engeland, Lamme, & Kemner, 2008). Also, both V1 and the fusiform gyrus were identified as part of an anterior-posterior axis that leads from fragment-based coding into a more holistic visual presentation respectively (Lerner, Hendler, & Malach, 2001). The negative correlation between disengagement and V1 suggests that disengagement might be associated with differences in detailed visual processing, while the positive correlations with the fusiform areas indicate that disengagement might be associated with differences in global visual processing.

When we controlled for the factors of the Big Five, the correlations between the different structures and both differences in decisiveness and disengagement remained significant (see Table 5.4 and 5.5; see also Diefendorff et al., 2000; Koole, 2004; Baumann & Kuhl, 2002). As such, individual differences in action versus state orientation appear to explain distinctive variance in the structural properties of the brain.

The current study is not without limitations. We analyzed the VBM values based on two T1 3D scans of each participant, and the FA values based on two DWI SE-EPI measurements of each participant. These measurements are not independent and therefore the thresholds to define regions of interest (200 voxels at $p < .01$ for VBM and 150 voxels at $p < .05$ for DTI) could be considered lenient. Moreover, recent work has shown that these thresholds may not properly control for false positives (Eklund, Nichols, & Knutsson, 2016). Therefore, the applied thresholds do not allow drawing strong conclusions and the current results require replication in an independent follow-up study.

In sum, the present exploratory work provides an initial exploration ofthe brain correlates of individual differences decisiveness and disengagement, two key facets of action versus state orientation (Kuhl & Beckmann, 1994). Indeed, the current findings suggest that decisiveness and rumination have separable structural neural correlates. This indicates that even if differences in both facets sometimes result in similar behavior and even if the constructs sometimes correlate, the processes leading to this behavior appear to have, at least partly, different underlying neural structures. More generally, the present research indicates that even if personality constructs are behaviorally correlated, this does not mean that these constructs necessarily have an identical neural basis.

5

CHAPTER 6

General Discussion

| General Discussion

The current dissertation focused on cognitive processes underlying individual differences in action orientation and cognitive control. In this final chapter of the dissertation, we summarize the methods and the main findings of the three empirical chapters. In addition, we will discuss the theoretical implications and limitations of this work and suggest directions for future research. We end by considering some of the practical implications of the current research.

| Summary of the Empirical Chapters

Chapter 3

Our goal in the third chapter of this dissertation was to investigate whether state-oriented people generally show less cognitive control than action-oriented people in demanding situations because they experience difficulties keeping their goals active, or whether a stronger focus on their intentions paradoxically impairs cognitive control. In previous work, lower cognitive control among state-oriented people compared to action-oriented people had been explained in terms of goal neglect, implying that intentions were not activated strongly enough in memory to keep the task goals active (Jostmann & Koole, 2007). However, this explanation seems to be at odds with earlier findings that state-oriented people keep their intentions more active in memory (Kuhl & Beckmann, 1994). According to the over-maintenance hypothesis, state-oriented people indeed keep their intentions more active in memory than action-oriented people, but have difficulties translating these intentions into action (Kuhl, 1994).

To provide a competitive test of the goal neglect versus over-maintenance mechanisms, in Study 3.1, we categorized participants as either action- or state-oriented based on their individual scores on the ACS90 (Kuhl, 1994). Furthermore, participants completed a measure of cognitive control (a Stroop task), for which they either received instructions to maximize or minimize reliance on conscious intentions. In a Stroop task participants have to name word colors while ignoring the words' meaning. Because reading is more automatic than color naming, color naming gets harder when colors are incongruent with word meanings (e.g. the word red displayed in a blue font). The latter effect is known as Stroop interference (Stroop, 1935; see MacLeod, 1991) and relates negatively to the level of cognitive control. The results of Study 3.1 yielded support for the over-maintenance hypothesis, which holds that control deficits among state-oriented people arise when they become cognitively preoccupied by their intentions. State-oriented people indeed showed significantly

less Stroop interference when they minimized (versus maximized) reliance on conscious intentions. As such, a stronger focus on intentions paradoxically impairs cognitive control for state-oriented people. Action-oriented participants, on the other hand, showed less Stroop interference when they maximized (versus minimized) reliance on conscious intentions, although the latter effect was not significant.

In Study 3.2, we conducted a more refined test of the over-maintenance hypothesis. Participants were again categorized as either action- or state-oriented and received instructions to either maximize or minimize reliance on conscious intentions to complete a cognitive task. The task we used in Study 3.2 was a task switching paradigm, in which participants categorized a target of a specific color in the first stage of the task, while ignoring distracters of a different color (Dreisbach and Goschke, 2004). During the second stage of the task, the target color changed, and the distracters appeared in the color of the former target. Furthermore, in compatible trials, the target and distracter required the same response, whereas in incompatible trials the target and distracter required a different response. The results of Study 3.2 again confirmed the over-maintenance hypothesis: state-oriented participants were slower to respond to incompatible trials after the switch than before the switch, indicating that for them it was harder to disengage from the old task goal once a new goal was introduced. Action-oriented participants did not show a significant difference in reaction times to incompatible trials after and before the switch, indicating that they were able to flexibly disengage from the old task goal, once a new task goal was introduced. Moreover, the results confirmed that state-oriented participants were able to focus strongly on their intentions; they showed reduced distractibility in the strong intentions focus condition compared to the weak intention focus condition, as expressed by a smaller difference between incompatible and compatible trials before the switch. For action-oriented participants no differences in distractibility between intention focus conditions were found.

Taken together, the results of Study 3.1 and Study 3.2 provide clear-cut support for the over-maintenance hypothesis. When state-oriented people focus more strongly on their goals, as indicated by lower distractibility, they perform less well on cognitive tasks and old task goals persevere in their intention memory. According to action control theory, state-oriented participants maintain their intentions in a narrow linguistic format that is disconnected from implicit knowledge structures about the self and the world that are needed for context-sensitive action. During maintenance of an intention, volitional inhibition delays the enactment of the intention to avoid premature action. Our results support the hypothesis that state-oriented people have difficulties releasing this volitional inhibition and initiating context-adequate action, resulting in over-maintenance of intentions. Moreover, our results do not support the hypothesis that state-oriented people are prone to goal neglect, and

therefore perform less well on cognitive tasks (Jostmann & Koole, 2007). In fact, our results demonstrate the opposite: it is exactly *because* state-oriented people keep their goals active in memory, that their performance on cognitive tasks is impaired.

Chapter 4

The results of Chapter 3 showed that a strong focus on intentions paradoxically impairs cognitive control among state-oriented people. Our results supported the hypothesis that state-oriented people tend to over-maintain their intentions as a result of a strong focus. However, our results could not explain why state-oriented people perform better when they focus weakly instead of strongly on their intentions. In Chapter 4, we investigated the cognitive processes underlying the performance of state-oriented individuals when they focus on their intentions weakly.

Although action-oriented individuals have frequently been found to outperform state-oriented people under demanding circumstances (e.g. Heckhausen & Strang, 1988; Jostmann & Koole, 2006; Kazén, Kaschel & Kuhl, 2008, Study 2) when the environment is less demanding, state-oriented individuals often perform at least equally well as their action-oriented counterparts. For example, when visualizing an accepting person, state-oriented individuals displayed larger working memory operation spans than action-oriented individuals (Jostmann & Koole, 2006). Furthermore, state-oriented individuals performed as well on a cognitive task as action-oriented individuals when pre-cues that triggered control were available (Jostmann & Koole, 2007). More in general, previous work suggests that state-oriented people have a performance advantage when they perform tasks under relaxed circumstances (Ruigendijk & Koole, 2014; Jostmann & Koole, 2006), or when the environment is supportive in triggering control (Jostmann & Koole, 2007). What remains unclear however, is which cognitive processes underlie state-oriented individuals' performance under relaxed circumstances and in an environment that triggers control. In Chapter 3 we suggest that under these circumstances, state-oriented individuals rely on reactive instead of proactive control processes. At the same time, we expect that action-oriented individuals rely on proactive instead of reactive control processes.

To investigate whether state-oriented individuals are indeed more prone to rely on reactive control processes than action-oriented individuals, we turned to the literature on congruency sequence effects. Congruency sequence effects are reactive in nature and occur when a response conflict in one trial (e.g. an incongruent trial in the Stroop task) may lead to improved control during the next trial (e.g. a next incongruent trial in the Stroop task; Botvinick, Braver, Barch, Carter, & Cohen, 2001). We measured congruency sequence effects in two different studies to test whether state-oriented individuals indeed rely on reactive control processes. In Study 4.1, we

categorized participants as either action- or state-oriented based on their individual scores on the ACS90 (Kuhl, 1994). Furthermore, participants completed a Stroop task with a high proportion of incongruent trials (66%). This renders the task less demanding, because the frequent incongruent trials serve as pre-cues that trigger increased levels of control. In the Stroop task, the congruency sequence effect was defined as a smaller Stroop interference effect after an incongruent than after a congruent trial. Participants either received instructions to maximize or to minimize reliance on conscious intentions.

The results of Study 4.1 supported our hypothesis that state-oriented individuals rely on reactive control processes more than their action-oriented counterparts. Among state-oriented participants, the congruency sequence effect was stronger when they focused on their intentions weakly than among action-oriented participants. When state-oriented individuals focused on their intentions strongly, the congruency sequence effect disappeared. We interpret these findings as support for the notion that state-oriented individuals indeed rely on reactive control processes instead of proactive control processes when they minimize reliance on conscious intentions. Among action-oriented participants no congruency sequence effects were found in any condition. Furthermore, among action-oriented participants, the Stroop effect was less strong than among state-oriented participants in Study 4.1. Apparently, action-oriented individuals are less prone to make use of reactive control processes, and rely on proactive control instead.

Because congruency sequence effects are usually more pronounced when the Stroop task contains fewer incongruent trials (Kane & Engle, 2001), in the second study we conducted a Stroop task with only 33% incongruent trials. Participants were again categorized as action- or state-oriented depending on their individual scores on the ACS90 (Kuhl, 1994). During the Stroop task we varied whether participants were exposed to visual pre-cues that made the Stroop task either harder or easier. We expected that large pre-cues, which decrease the salience of word meaning (Chen, 2003), would enable state-oriented participants to reactively rely on the environment to adjust their visual attention for them. Small pre-cues, which increase the salience of word meaning (Chen, 2003) were not expected to increase reliance on reactive control processes. Moreover, participants either received instructions that maximized or minimized reliance on conscious intentions, or they received no intention focus instructions.

The results of Study 4.2 further supported our hypothesis that state-oriented individuals are more prone to rely on reactive control processes. In the large pre-cue condition state-oriented participants showed the congruency sequence effect when they were focused on their intentions weakly. Moreover, the Stroop effect disappeared among state-oriented participants in the weak intention focus condition. These findings suggest that relying on reactive control processes may be beneficial for the

performance of state-oriented individuals. Action-oriented participants did not show the conflict adaptation effect in any condition, which suggests that they are more prone to rely on proactive control processes.

Taken together, the results of Study 4.1 and Study 4.2 support our hypothesis that state-oriented individuals rely on reactive control processes when they perform a task under relaxed circumstances, and when the environment is supportive in triggering control. These findings are in line with our findings in Chapter 3, which showed that when state-oriented individuals focus on their goal strongly, they tend to over-maintain their intentions, paradoxically resulting in an impaired ability to initiate context-adequate action (Ruigendijk & Koole, 2014). Presumably this happens because under a strong intention focus, state-oriented individuals rely on rigid forms of control that are disconnected from the environment and from the supervisory control system that supports volitional functions. Importantly, the current findings suggest that when state-oriented individuals rely on reactive forms of control, they become more sensitive for signals from the environment that an increase in control is necessary.

Chapter 5

Despite the abundant behavioral literature on action and state orientation, little is known about its neural foundations. Therefore, in the Chapter 5 of this dissertation we investigated whether individual differences in action versus state orientation are reflected in the structure of the brain. In one of the few studies on the neural underpinnings of action versus state orientation, Rosahl, Tennigkeit, Kuhl, & Haschke, (1993) observed differences between action- and state-oriented individuals in event-related slow potential shifts during the processing of emotional stimuli. These findings provide insight in functional differences between action and state orientation. However, because action versus state orientation is a relatively stable personality disposition, differences might also be expressed in the structural parameters of the brain. In Chapter 5, we investigated the relationship between the direction and density of white matter tracts and the concentration of gray matter with individual differences in action versus state orientation. Moreover, we investigated whether two different facets of action versus state orientation, i.e. the demand-related facet and the threat- related facet, had separable or common denominators in the brain.

The results showed that individual differences in action versus state orientation indeed relate to gray and white matter structures in the brain. Although, in first instance, we did not find any gray matter areas that were shared between the demand-related and the threat-related facet of action versus state orientation, in a supplementary analysis, we found that the volume of several specific gray matter areas was uniquely correlated with only one facet, while the volume of several other specific gray matter areas varied depending on the correlation between the demand-

related and threat-related facet of action versus state orientation. These findings are consistent with factor-analytic and behavioral evidence that the demand-related and threat-related facets of action versus state orientation are separable, but mutually related aspects of volitional action control (Kuhl & Beckmann, 1994).

More specifically, demand-related action versus state orientation was uniquely and positively related to two striatal structures: the bilateral caudate nucleus and the nucleus accumbens. Functionally, these areas have been indicated as playing a role in reward perception, outcome evaluation and in decision making under time pressure (Robbins & Everitt, 1992; for a review see Balleine, Delgado, & Hikosaka, 2007; Forstmann et al., 2008). The correlation between the caudate and accumbens with demand-related action versus state orientation is thus perfectly in line with the manifestation of demand-related action orientation as decisiveness under pressure (Kuhl & Beckmann, 1983; see Koole, Jostmann, & Baumann, 2012, for a review). Moreover, we found a positive correlation between demand-related action orientation and a white matter tract deriving from the hippocampus. Atrophy of hippocampal dendrites has been related to chronic high stress levels (McEwen, 1999). Our results suggest that this effect may be more prominent among state-oriented individuals, who are less capable of down-regulating stress than their action-oriented counterparts (Baumann, Kaschel, & Kuhl, 2007; Koole & Jostmann, 2004).

Threat-related action orientation correlated positively with gray matter in Crus I in the cerebellum. Crus I plays an important role in implicit control of mental activities (Ito, 2005, 2006 & 2008) and might therefore prevent involuntary attention to negative thoughts. This finding thus suggests a new conception of threat-related action orientation as an improved ability to process thoughts non-consciously. Furthermore, more than half of the correlates with threat-related action versus state orientation were found in the gray matter of the visual cortex. Theoretically, the dominant perception system related to threat-related action orientation, is the ventral, as opposed to the dorsal stream (Kuhl & Koole, 2004; Kuhl, 2001). The correlates we found in the occipital pole and the bilateral fusiform areas, and the lack of correlates in the parietal cortex, confirm this theory.

When we controlled for the factors of the Big Five, the correlations between the different structures and both demand-related and threat-related action orientation remained significant. As such, individual differences in action versus state orientation appear to explain distinctive variance in the structural properties of the brain (see also Diefendorff, Hall, Lord, Strean, 2000; Koole, 2004; Baumann & Kuhl, 2002).

In sum, the findings of Chapter 5 provide evidence that demand-related and threat-related action orientation are related to separable structural neural correlates. At the same time, our data suggest that some neural structures might be shared between both facets of action orientation. Although these findings are in line with the notion

that action orientation indeed is a relatively stable trait-like construct, the present findings do not mean that an individual's predominant orientation cannot change over time. The structure of the brain is plastic and can change over time through practice, experience or stimulation (Luders, Toga, Lepore, & Gaser, 2009; Draganski et al., 2004; Draganski et al., 2006; May et al., 2007, Driemeyer, Boyke, Gaser, Buchel, & May, 2008; Boyke, Driemeyer, Gaser, Buechel, & May, 2008). Indeed a person's predominant orientation can change through therapy (de Jong-Meyer et al., 1999; Hartung & Schulte, 1994) and people tend to become more action-oriented with age (Gröpel, Kuhl, & Kazén, 2004). Thus, demand-related and threat-related action orientation represent relatively stable, but changeable aspects of personality.

Theoretical Contributions, Limitations, and Future Directions

The current dissertation has theoretically contributed to the existing literature on action versus state orientation, intentions, and cognitive control. Throughout the dissertation, we have investigated action control utilizing the well-established Stroop task, thus extending the existing literature on the Stroop paradigm and on the congruency-sequence effect. Moreover, we have investigated the structural neural correlates of action versus state orientation. As such, the work in this dissertation bridges the literature on action versus state orientation and cognitive control with the literature on intentional control and neuroscience.

The current dissertation has provided three important theoretical contributions. First, through our investigations we have been able to distinguish between goal neglect and the over-maintenance of intentions as an underlying reason for lapses in control among state-oriented individuals. Although a decrease in cognitive control during the Stroop task had been explained in terms of goal neglect before (Jostmann & Koole, 2007), in Chapter 3 we have demonstrated that the process of over-maintaining intentions is a more probable explanation for this effect. An explanation in terms of over-maintenance fits the existing theory that state-oriented people often are preoccupied with their intentions, paradoxically resulting in impaired context-adequate enactment of intentions (Kuhl, 2000). The current study mainly focused on explaining action control deficits among state-oriented people, and thus devoted less attention to the processes underlying the flexibility in action control among action-oriented people. Kuhl (2000) has suggested that action-oriented people may release volitional inhibition through up-regulation of positive affect. Future research should therefore investigate whether positive affect is a mediator between the effects of our focus condition on action control among action-oriented people. Second, we have gained insight in the cognitive processes underlying control under relaxed circumstances among state-oriented individuals. In Chapter 3 we found that state-oriented individuals perform better when they relax than when they consciously focus on their intentions. In

Chapter 4 we have demonstrated that the control processes underlying state-oriented individuals' performance under relaxed circumstances are reactive in nature. Action-oriented individuals did not display any detectable reactive processes. The results of Chapter 4 suggest that action-oriented people rely on more proactive control processes. However, further research is needed to gain a more detailed insight in these proactive control processes. Tasks that are designed specifically to measure proactive control processes (e.g. the AX version of the continuous performance task (AX-CPT; Servan-Schreiber, Cohen, Steingard, 1996) could provide a direct test of differences in proactive control processes between action- and state-oriented people.

Third, we have gained more insight in the neural foundations underlying action versus state orientation. The neural correlates we have found confirm the theory that the demand-related and threat-related action orientation are separable but related facets of a trait-like construct. Moreover, the specific correlates relate demand-related action orientation to stress management and reward sensitivity, which is perfectly in line with behavioral correlates of this facet of action orientation. The neural correlates of threat-related action orientation in the ventral visual stream perfectly fit the theory that object recognition serves an important monitoring function in relation to self-regulation and AOT (Kuhl & Koole, 2004). Furthermore, the correlates in crus I of the cerebellum, suggests a new conception of threat-related action orientation as an improved ability to process thoughts non-consciously (Ito, 2005, 2006 & 2008). Further research is needed to validate this intriguing possibility. Functional magnetic resonance imaging (fMRI) combined with a task that measures intuitive processing (e.g. the Judgment of Semantic Coherence Task (JSCT; Baumann & Kuhl, 2002) could provide more insight in differences in brain activity in the cerebellum between action- and state-oriented people.

For all studies in the current dissertation we have only recruited students as participants. Therefore, it is difficult to estimate whether our results generalize to people who are younger and older than the age group we have studied. Research has shown that action orientation (versus state orientation) is positively correlated with age (e.g. Hennecke & Freund, 2016). Consequently, it would be of great value to replicate the current studies with participants from different age groups. Another variable that might moderate the effects that we have found in the current dissertation, is how stressful people's living environment people is on average. For example, the effects of the focus manipulation we utilized in the current dissertation, might differ depending on whether people live in a mastery culture that is focused on success, ambition, and performance, or whether people live in a harmony culture that is focused on a world at peace, unity with nature, and protecting the environment (Schwartz, 2006). Therefore, it would be of great value to replicate the current studies with participants from countries varying on the mastery versus harmony dimension.

Practical Implications

The current dissertation shows that individual differences in action versus state orientation play an essential role in how control is optimally exerted. One of the most important practical implications of this dissertation derives from the finding that state-oriented people were able to improve their performance when they were in a relaxed (as opposed to focused) mindset (Chapter 3). Hitherto, there had been a lot of attention in the literature for how demanding circumstances deteriorate the performance of state-oriented people, while less demanding circumstances sometimes improve their performance (e.g. Jostmann & Koole, 2006, 2007). It might often be difficult, however, to influence the circumstances to become less demanding. To change one's own mindset to be relaxed instead of focused, although still challenging, seems a more realistic possibility. To improve their self-relaxation skills, state-oriented people could, for example, practice meditation with an emphasis on mindfulness training (Ruigendijk & Koole, 2011; Creswell, 2016). Action-oriented people, on the other hand, could benefit from meditation with an emphasis on concentration training.

The findings of the present dissertation also have implications for leadership styles. State-oriented people appear to perform best when they are in a relaxed mindset. Moreover environmental cues enable state-oriented people to rely on reactive control processes, which benefits their performance. Therefore, when managing a state-oriented person, a supportive and directive leadership style is likely to be most effective. Furthermore, because action-oriented people perform better when under pressure and on demanding tasks, for them an achievement-oriented leadership style may be most effective.

Concluding remarks

An abundant literature has identified differences between action- and state-oriented people in the ability to perform under pressure. The current dissertation has provided a deeper insight in the cognitive processes underlying these differences. Importantly, our results demonstrate that state-oriented people often perform less well under pressure, not because they lose sight of their goals, but exactly because they keep their goals active in memory. When state-oriented people relax, they rely on reactive control processes and become more sensitive to action-related cues in their environment. Furthermore, our results support earlier findings (Diefendorff et al., 2000) that action orientation in dealing with threats relies on different neural structures than action orientation in dealing with demanding situations. The most important message of the current dissertation is that it is essential to take into account individual differences in action control when deciding on strategies to optimize performance.

6

ENGLISH SUMMARY

Summary

Success in any area of life is dependent on people's ability to turn their intentions into actions. No matter how strong people's intentions are, it is the step towards action that determines whether people are able to turn their intentions into to reality. Whether it is finishing the do it yourself home project that has been almost done for months, sticking to an exercise regimen, or practicing a new musical instrument every day, it is the action, and not the intention, that determines progress. Although it may sound simple, taking this crucial step towards action often turns out to be harder than anticipated, especially when obstacles or complications occur.

According to action control theory (Kuhl, 1994) people vary widely in their ability to enact intentions. So called state-oriented people struggle more often with enacting their intentions than so-called action-oriented people, especially in situations that require self-regulated control. For example, in real life settings, state-oriented people are less successful dieters (Palfai, 2002), have more difficulties finding employment (Song, Wanberg, Niu, & Xie, 2006), and experience more difficulties breaking a personal athletic record (Heckhausen & Strang, 1988). Moreover, in controlled laboratory settings, state-oriented people show impaired performance on cognitive tasks under demanding circumstances (Jostmann & Koole, 2006, 2007). The goal of the current dissertation is to advance the understanding of the processes underlying these differences in the enactment of intentions between action- and state-oriented people.

In Chapter 1, we first introduce action control theory (Kuhl, 1985) as a framework for understanding differences in the ability to enact intentions. Then we present a short overview of each chapter of the current dissertation.

In Chapter 2, we discuss two competing theoretical explanations for these differences in goal-enactment related to action versus state orientation. One explanation can be found in the goal neglect hypothesis, which holds that state-oriented people are more prone to lose sight of their goals under demanding circumstances because their goal focus is not strong enough (Kane & Engle, 2003; Jostmann & Koole, 2007, study 3). An alternative explanation for the differences in goal-enactment between action and state-oriented people can be found in the over-maintenance hypothesis. This hypothesis holds that people maintain their intentions in their working memory, and that to avoid premature action, the cognitive maintenance of an intention is accompanied by inhibition of automatic behavioral routines, or 'volitional inhibition' (Braver, Gray, & Burgess, 2007; Goschke & Kuhl, 2003; Kuhl & Kazén, 1999). Releasing this inhibition is critical to enable flexible and efficient action initiation. Action-oriented people are capable of releasing volitional inhibition rapidly and efficiently. On the other hand, because state-oriented people maintain their intentions more

strongly, they are expected to show stronger volitional inhibition. Therefore, it would be more difficult for state-oriented people to flexibly release volitional inhibition, resulting in behavioral passivity. In short, focusing on intentions may paradoxically impair the enactment of intentions among state-oriented people.

In Chapter 3 we empirically test the over-maintenance hypothesis versus the goal neglect hypothesis in two different experiments. In both experiments, participants performed different cognitive tasks that require initiative and self-directed control. Additionally, in the second experiment we measured how well participants were able to disengage from an existing intention, when this intention was replaced by a new one. In both experiments we measured whether participants were action- or state oriented. Half of the participants were instructed to be as active as possible and to consciously direct their attention to determine their response (strong intention focus condition). The other half of the participants were instructed to relax and let the right answer 'pop' into their minds (weak intention focus condition). The over-maintenance hypothesis predicts that state-oriented people would perform difficult actions less efficiently when focusing more strongly on the task goal. By contrast, the goal neglect hypothesis predicts that state-oriented people would perform difficult actions less efficiently when focusing less strongly on the task goal.

In both experiments reported in Chapter 3, action-oriented participants performed better in the strong intention focus condition than in the weak intention focus condition. Conversely, state-oriented participants performed better in the weak intention focus condition than in the strong intention focus condition. Moreover, it was easier for state-oriented participants to let go of earlier intentions in the weak intention focus condition than in the strong intention focus condition. These results support the over-maintenance hypothesis, and not the goal neglect hypothesis, because the performance of state-oriented participants deteriorated when they focused on their intentions more strongly.

In Chapter 4, we tested whether these differences in performance under relaxed and demanding circumstances can be explained by underlying qualitative differences in the control processes action- and state-oriented people use. More specifically, we hypothesized that action-oriented people perform better when they rely on proactive control processes, whereas state-oriented people perform better when they rely on reactive control processes. During reactive control processes, people rely on environmental cues to determine their course of action. During proactive control processes, on the other hand, people rely on self-directed control, independent of the environment. If state-oriented people indeed rely on reactive control processes when they relax, they should benefit more from external cues than action-oriented people. Consistent with this, Kazén, Kaschel, and Kuhl (2008) found that providing helpful pre-cues led to a greater speed-up in action initiation times among state-oriented

people than among their action-oriented counterparts. Thus, there is initial evidence that pre-cues may be particularly beneficial to state-oriented people, consistent with their presumed reliance on reactive control.

In Chapter 4 we tested in two experiments (Study 4.1 and 4.2) whether state-oriented people indeed rely more on reactive control processes than action-oriented people when they relax. In the first experiment, participants performed a task that leaves ample room for reactive control processes to emerge. In the second experiment, participants performed a task that contained pre-cues that either made the task easier or more difficult. In both experiments, half of the participants were instructed to be as active as possible and to consciously direct their attention to determine their response (strong intention focus condition). The other half of the participants were instructed to relax and let the right answer 'pop' into their minds (weak intention focus condition). Furthermore we measured whether participants were action- or state-oriented. The results of the first experiment confirmed that state-oriented participants indeed relied on reactive control processes in the weak intention focus condition. No signs of reliance on reactive control processes were found for action-oriented participants. In the second experiment, reactive control processes only emerged among state-oriented participants when pre-cues were available that made the task easier. Again, no signs of reactive control processes were found for action-oriented participants. Therefore, both experiments confirm our hypothesis that state-oriented people rely on reactive control processes when they relax.

The differences in cognitive control between action- and state-oriented people that we have found in the Chapters 3 and 4 were all related to one specific facet of action orientation: the demand-related facet. However, action control theory has distinguished additional facets of action orientation. Besides demand-related action orientation (hesitation versus initiative), threat-related action orientation (preoccupation versus disengagement) is another well-established facet of action control. People who are action-oriented on the threat-related facet are able to easily disengage from failure and other causes of cognitive intrusions. People who are state-oriented on the treat-related facet have difficulties disengaging from failure and cognitive intrusions. The underlying common denominator of both facets is that action orientation is associated with behavioral facilitation, whereas state orientation is associated with behavioral inhibition.

In Chapter 5, we examine whether individual differences in both facets of action orientation are related to the volume and concentration of gray matter and the direction and density of white matter tracts in the brain (study 5). Gray matter consists of the brain tissue that contains neural cell bodies and is an elementary component of the brain that processes and structures sensory and cognitive information. Individual differences in gray matter that are related to action orientation therefore

reflect differences in information processing that are more structural and long-lasting than the transient influence of the environment or a temporary state of mind. White matter primarily consists of myelinated axon bundles that connect gray matter areas and enable messages to travel between these areas. Individual differences in white matter that are related to action orientation therefore reflect structural differences in communication between different brain areas.

The demand-related and the threat-related facets of action orientation have emerged as separate psychometric dimensions (Diefendorff, Hall, Lord, & Strean, 2000; Kuhl, 1994; Papantoniou, Moraitou, Dinou, & Katsadima, 2010), and were found to have differential behavioral correlates (e.g., Baumann, Kaschel, & Kuhl, 2005; Koole, 2004). However, in other studies, correlations between decisiveness and disengagement in the .40s and higher were observed (e.g., Blunt & Pychyl, 1998; Frese, Fay, Hilburger, Leng, & Tag, 1997; Rholes, Michas, & Shroff, 1989). Indeed, several studies aggregated decisiveness and disengagement values into a single score, presumably because similar patterns of behavioral correlates were found for the two constructs (e.g., Blunt & Pychyl, 2005; Rholes et al., 1989). The latter studies raise the question whether decisiveness and disengagement might be considered one and the same. Therefore, in Chapter 5, we studied the underlying neuro-architecture of both facets of action orientation. Moreover, we examined whether the correlations between action orientation and gray and white matter were still found when controlled for personality differences in the factors of the Big Five (openness to experience, conscientiousness, extraversion, agreeableness and emotional stability).

Our results showed that the demand-related and threat-related facet action orientation correlated with separate and non-overlapping differences in gray matter volume and white matter density. Individual differences in the demand-related facet were uniquely correlated with gray matter in brain areas that are associated with decision-making under time pressure, reward perception and outcome evaluation. Moreover we found a positive correlation between demand-related action orientation and white matter density in brain areas that are related to stress sensitivity. Threat-related action orientation correlated with an area that is associated with implicit thinking. This finding suggests a new conception of threat-related action orientation as a consequence of an improved ability to process thoughts non-consciously. The correlations between action orientation and gray and white matter remained significant when controlled for the factors of the Big Five. As such, individual differences in action versus state orientation appear to explain distinctive variance in the structural properties of the brain (see also Diefendorff et al., 2000; Koole, 2004; Baumann & Kuhl, 2002).

Since the 1990s, action orientation has been extensively studied. At a theoretical level, the current dissertation has added to existing knowledge by providing the

insight that the different facets of action orientation have a different underlying neuro-architecture. This implies that there is a neurological basis for distinguishing between demand-related and threat-related action orientation. This conclusion meshes well with psychometric research supporting the distinction between demand-related and threat-related action orientation as different psychometric dimensions (Diefendorff et al., 2000). In future studies it would therefore seem continue to analyze the effects of both facets separately.

Moreover, with the current dissertation we have deepened the insights in the cognitive processes that play a role in the different functioning of action- and state-oriented people. More specifically, our results indicate that state-oriented people experience more difficulties in enacting their intentions, exactly because they focus strongly on their intentions. Furthermore, we have found that state-oriented people show an increase in cognitive performance when they are able to rely on reactive control processes.

These insights could be applied to optimize the performance of state-oriented people. Because state-oriented people benefit from 'letting go' of their intentions, they could profit from mindfulness meditation (see also Ruigendijk & Koole, 2011). When state-oriented people are trained in acceptance and 'letting go' and are able to apply these techniques under demanding circumstances, this could improve their performance. Moreover, the insights that were gained by this dissertation could have practical implications for the work environment. The current research suggests that state-oriented people perform best when they are in a relaxed mindset. Moreover, environmental cues enable state-oriented people to rely on reactive control processes, which benefits their performance. Therefore, when managing a state-oriented person, a supportive and directive leadership style would be most effective. Furthermore, because action-oriented people perform better when under pressure and on demanding tasks, for them an achievement-oriented leadership style would be most effective.

NEDERLANDSE SAMENVATTING
Dutch Summary

Nederlandse Samenvatting (Summary in Dutch)

Hoe succesvol mensen zijn op allerlei gebieden in het leven, wordt voor een groot deel bepaald door hoe goed zij hun intenties kunnen omzetten in gedrag. Hoe sterk hun intenties ook zijn, het is de cruciale stap naar actie die bepaalt of mensen hun intenties tot realiteit kunnen maken. Of het nu gaat om het afmaken van een doe-het-zelf project dat al maanden bijna klaar is, twee keer per week naar de sportschool gaan, of iedere dag een nieuwe taal oefenen, het is de actie, en niet de intentie, die ervoor zorgt dat er vooruitgang wordt geboekt. Ook al klinkt dit misschien simpel, het daadwerkelijk zetten van die cruciale stap van intentie naar actie, is vaak moeilijker dan van te voren gedacht, vooral als er obstakels zijn of zich complicaties voordoen.

Volgens de Actie-Controle-Theorie (Kuhl, 1994) zijn er grote verschillen tussen mensen in hoe goed zij hun intenties kunnen omzetten in gedrag. Toestandsgeoriënteerde mensen hebben vaker dan actiegeoriënteerde mensen moeite met het uitvoeren van intenties, vooral in situaties waarin veel zelfgestuurde controle nodig is. Zo hebben toestandsgeoriënteerde mensen meer moeite om zich aan een dieet te houden (Palfai, 2002), werk te vinden (Song et al., 2006) of een persoonlijk atletisch record te breken (Heckhausen en Strang, 1988). Daarnaast presteren toestandsgeoriënteerden minder goed dan actiegeoriënteerden op cognitieve taken wanneer zij onder druk staan (Jostmann & Koole, 2006; 2007). Tegelijkertijd is bekend dat toestandsgeoriënteerde mensen juist een beter intentiegeheugen hebben dan actiegeoriënteerden (Goschke & Kuhl, 1993). Hoewel toestandsgeoriënteerden dus juist sterk gericht zijn op hun intenties, brengen zij deze minder vaak ten uitvoer dan hun actiegeoriënteerde tegenpolen.

In Hoofdstuk 1 introduceren we eerst de Actie-Controle-Theorie (Kuhl, 1985) als een raamwerk om de individuele verschillen in het uitvoeren van intenties te kunnen begrijpen. Daarna geven we een kort overzicht van ieder hoofdstuk van dit proefschrift.

In Hoofdstuk 2 bespreken we twee tegenstrijdige theoretische verklaringen voor de individuele verschillen in het uitvoeren van intenties die gerelateerd zijn aan actie- en toestandsoriëntatie. De eerste verklaring is de 'goal neglect'-hypothese, die inhoudt dat toestandsgeörienteerde mensen hun doelen eerder uit het oog verliezen in veeleisende omstandigheden, omdat hun doelfocus niet sterk genoeg is (Kane & Engle, 2003; Jostmann & Koole, 2007, study 3). De 'over-maintenance'- hypothese biedt alternatieve verklaring voor de individuele verschillen in het uitvoeren van intenties. Volgens deze hypothese onderhouden mensen een gevormde intentie in hun werkgeheugen (Braver et al., 2007; Goschke en Kuhl, 2003). Doordat een intentie in veel gevallen niet direct kan worden omgezet in gedrag, bijvoorbeeld omdat het juiste moment nog niet daar is, gaat de intentie in het werkgeheugen gepaard met volitionele inhibitie (Kuhl en Kazén, 1999). Volitionele inhibitie voorkomt dat een intentie prematuur ten uitvoer wordt gebracht. Om een intentie op het juiste moment om te zetten in gedrag, is het

loslaten van volitionele inhibitie van cruciaal belang. Actiegeoriënteerde mensen zijn inderdaad in staat om deze volitionele inhibitie snel en efficiënt los te laten. Doordat toestandsgeoriënteerde mensen zo sterk op het onderhouden van hun intenties gericht zijn, is het proces van volitionele inhibitie bij hen echter sterker. Daardoor is het voor hen moeilijker dan voor actiegeoriënteerden om volitionele inhibitie op een flexibele manier los te laten, met passiviteit tot gevolg. Kort samengevat zou men dus kunnen zeggen dat toestandsgeoriënteerde mensen juist moeite hebben om in actie te komen doordát ze zo sterk op hun intenties gericht zijn.

In Hoofdstuk 3 toetsten we de 'over-maintenance'-hypothese versus de 'goal neglect'-hypothese. In twee experimenten (Studie 3.1 en 3.2) vroegen wij deelnemers verschillende taken te doen waarvoor veel zelfgestuurde controle nodig is. In het tweede experiment werd daarnaast gemeten hoe makkelijk deelnemers eerdere intenties konden loslaten op het moment dat hier een nieuwe intentie voor in de plaats kwam. In beide experimenten kreeg de helft van de deelnemers de opdracht de aandacht sterk te richten op het goed uitvoeren van de taak. De andere helft van de deelnemers kreeg de opdracht zich te ontspannen en het juiste antwoord als vanzelf in zich op te laten komen. Daarnaast werd gemeten of de deelnemers actie- of toestandsgeoriënteerd waren. Uit beide experimenten bleek dat deelnemers die actiegeoriënteerd waren, beter presteerden dan toestandsgeoriënteerden wanneer zijn hun aandacht bewust richtten op de taak. Daarentegen presteerden toestandsgeoriënteerden juist beter dan actiegeoriënteerden wanneer zij zich ontspanden en het juiste antwoord als vanzelf in zich lieten opkomen. Ook was het voor hen makkelijker eerdere intenties los te laten op het moment dat ze ontspanden. Deze resultaten ondersteunen de over-maintenance hypothese. Toestandsgeoriënteerden presteerden immers minder goed naarmate zij hun aandacht sterker richtten op hun intenties.

In Hoofdstuk 4 toetsten we of de verschillen in prestaties onder ontspannen en veeleisende omstandigheden tussen actie- en toestandsgeoriënteerde mensen, kunnen worden verklaard door kwalitatieve verschillen in de controleprocessen die zij gebruiken. Meer specifiek, veronderstelden wij dat actiegeoriënteerde mensen beter presteren wanneer zij vertrouwen op proactieve controleprocessen, terwijl toestandsgeoriënteerde mensen juist beter presteren wanneer zij vertrouwen op reactieve controleprocessen. Tijdens reactieve controleprocessen vertrouwen mensen op 'cues' uit de omgeving om hun gedrag te sturen. Aan de andere kant vertrouwen mensen tijdens proactieve controleprocessen op zelfgestuurde controle, onafhankelijk van de omgeving. Als toestandsgeoriënteerden dus inderdaad vertrouwen op reactieve controleprocessen op momenten dat zij zich ontspannen, zouden zij meer moeten profiteren van externe 'cues' dan actiegeoriënteerde mensen. Een eerste aanwijzing hiervoor is gevonden in eerder onderzoek (Kazén et al., 2008)

waarin toestandsgeoriënteerde mensen een grotere afname van actie-initiatie-tijden lieten zien dan actiegeoriënteerde mensen wanneer sturende 'pre-cues' aanwezig waren.

In Hoofdstuk 3 deden we twee experimenten (Studie 4.1 en 4.2) om te testen of toestandsgeoriënteerde mensen inderdaad meer vertrouwen op reactieve controleprocessen dan actiegeoriënteerde mensen wanneer zij zich ontspannen. In het eerste experiment kregen de deelnemers een taak die veel ruimte laat voor het optreden van reactieve controleprocessen. In het tweede experiment kregen de deelnemers een taak waarbij sturende 'pre-cues' verschenen die de taak moeilijker of makkelijker maakten. In beide experimenten kreeg de helft van de deelnemers weer de opdracht de aandacht sterk te richten op het goed uitvoeren van de taak. De andere helft van de deelnemers kreeg de opdracht zich te ontspannen en het juiste antwoord als vanzelf in zich op te laten komen. Uit het eerste experiment bleek inderdaad dat reactieve controleprocessen wel voorkwamen bij toestandsgeoriënteerde deelnemers die zich ontspanden, maar niet bij actiegeoriënteerde deelnemers. Uit het tweede experiment bleek dat reactieve controleprocessen alleen optraden bij toestandsgeoriënteerde deelnemers wanneer 'pre-cues' verschenen die de taak makkelijker maakten. Ook in dit experiment kwamen reactieve controleprocessen niet voor bij actiegeoriënteerde deelnemers. Beide experimenten bevestigen dus onze hypothese dat toestandsgeoriënteerde mensen vertrouwen op reactieve controleprocessen wanneer zij zich ontspannen.

De verschillen in cognitieve controle tussen actie- en toestandsgeoriënteerden die we in de Hoofdstukken 2 en 3 hebben gevonden, waren allemaal gerelateerd aan één specifieke component van actieoriëntatie: de daadkrachtcomponent. Actieoriëntatie kan echter onderverdeeld worden in meerdere facetten. Naast de daadkrachtcomponent, is de 'disengagement'-component een veel bestudeerd facet van actieoriëntatie. Mensen die actiegeoriënteerd zijn op de 'disengagement'-component kunnen falen en andere oorzaken van cognitieve intrusies makkelijk loslaten. Aan de andere kant hebben mensen die toestandsgeoriënteerd zijn op de 'disengagement'-component juist eerder last van cognitieve intrusies en moeite met loslaten. De onderliggende gemeenschappelijke deler van beide facetten (daadkracht en 'disengagement') is dat actieoriëntatie gepaard gaat met gedragsfacilitatie, terwijl toestandsoriëntatie gepaard gaat met gedragsinhibitie.

In Hoofdstuk 5 onderzochten we hoe individuele verschillen in beide facetten van actie- en toestandsoriëntatie gerelateerd waren aan het volume en de concentratie van de grijze stof en aan de richting en dichtheid van de witte stof in het brein (Studie 5).

Grijze stof bestaat uit de cellichamen en dendrieten van de hersencellen en is een elementair onderdeel van het brein dat sensorische en cognitieve informatie structureert. Individuele verschillen in de grijze stof die gerelateerd zijn aan

actieoriëntatie reflecteren dus verschillen in informatieverwerking die structureler en langduriger zijn dan de kortdurende invloed van de omgeving of een tijdelijke staat van zijn. Witte stof bestaat uit gemyeliniseerde axonbundels die de gebieden van grijze stof met elkaar verbinden. Witte stof zorgt ervoor dat er communicatie mogelijk is tussen de verschillende gebieden van grijze stof. Individuele verschillen in witte stof die gerelateerd zijn aan actieoriëntatie reflecteren dus structurele verschillen in communicatie tussen verschillende hersengebieden.

Hoewel de daadkracht- en 'disengagement'-component van actieoriëntatie als twee aparte psychometrische dimensies naar voren zijn gekomen uit onderzoek (Dieffendorf et al., 2000; Kuhl, 1994; Papantoniou et al., 2010) en correleren met verschillende gedragingen (bijv. Baumann et al, 2005; Koole, 2004), zijn er ook correlaties van .40 en hoger tussen beide componenten gevonden (bijv. Blunt & Pychyl, 1998; Frese et al., 1997; Rholes et al., 1989). In meerdere studies werden de daadkracht- en 'disengagement'-componenten van actieoriëntatie zelfs geaggregeerd in één score, omdat er vergelijkbare patronen van gedragscorrelaten werden gevonden voor de twee constructen (Blunt & Pychyl, 2005; Rholes et al., 1989). De laatste studies doen de vraag rijzen of de daadkracht- en 'disengagement'-componenten beschouwd zouden kunnen worden als één en hetzelfde construct. Daarom onderzochten we in Hoofdstuk 4 de onderliggende neuro-architectuur van beide componenten. Daarnaast onderzochten we of de correlaties tussen actieoriëntatie en de grijze en witte stof overeind bleven als ze werden gecontroleerd voor persoonlijkheidsverschillen in de 'Big Five'-factoren (openheid voor ervaringen, consciëntieusheid, extraversie, inschikkelijkheid en emotionele stabiliteit).

Uit de resultaten van ons onderzoek bleek dat daadkracht en 'disengagement' correleerden met verschillende en niet-overlappende verschillen in het volume van de grijze stof en de dichtheid van de witte stof. Individuele verschillen in daadkracht hadden een unieke correlatie met het volume van de grijze stof in hersengebieden die betrokken zijn bij besluitvorming onder druk, beloningsperceptie en evaluatie van uitkomsten. Daarnaast werd een positieve correlatie gevonden tussen daadkracht en de dichtheid van witte stof in hersengebieden gerelateerd aan gevoeligheid voor stress. 'Disengagement' correleerde met een gebied dat betrokken is bij impliciet denken. Deze bevinding schijnt een nieuw licht op 'disengagement' als een consequentie van een verbeterde onbewuste verwerking van gedachten. Wanneer gecontroleerd werd voor de factoren van de 'Big Five' bleven de correlaties tussen actieoriëntatie en de grijze en witte stof significant. De belangrijkste conclusie van het onderzoek in Hoofdstuk 4 is dat daadkracht en disengagement in het brein verschillende correlaten hebben.

Actieoriëntatie is al sinds de jaren negentig van de vorige eeuw een grondig onderzocht construct. Onderzoekstechnisch heeft dit proefschrift het inzicht

opgeleverd dat de verschillende facetten van actieoriëntatie een verschillende onderliggende neuro-architectuur hebben. Voor het integreren van de verschillende componenten (daadkracht en 'disengagement') is dus geen neurologische basis. Ook uit ander onderzoek zijn deze componenten naar voren gekomen als verschillende psychometrische dimensies (Dieffendorf, 2000). In toekomstig onderzoek zou het dus verstandig zijn de effecten van beide componenten gescheiden te analyseren.
Met dit proefschrift hebben we bovendien de inzichten in de cognitieve processen die een rol spelen bij de verschillen in functioneren tussen actie- en toestandsgeoriënteerde mensen verdiept. Meer specifiek is duidelijk geworden dat toestandsgeoriënteerde mensen hun intenties soms minder snel ten uitvoer brengen dan actiegeoriënteerde mensen, juist doordát zij zich sterker op hun intenties focussen. Daarnaast is duidelijk geworden dat toestandsgeoriënteerde mensen betere cognitieve prestaties leveren wanneer zij kunnen vertrouwen op reactieve controleprocessen.

In de praktijk zouden deze inzichten kunnen worden toegepast om het functioneren van toestandsgeoriënteerde mensen te optimaliseren. Omdat toestandsgeoriënteerde mensen juist baat hebben bij het 'loslaten' van hun intenties, zouden zij kunnen profiteren van mindfulness-meditatie (zie ook Ruigendijk & Koole, 2011). Wanneer zij getraind worden in accepterende cognitie en 'loslaten' en deze technieken kunnen toepassen op momenten dat zij zich in een veeleisende omgeving bevinden, zou dit hun prestaties zeker ten goede kunnen komen. De inzichten die dit proefschrift hebben opgeleverd zouden daarnaast kunnen worden toegepast door managers op de werkvloer. Voor toestandsgeoriënteerde mensen is het belangrijk dat een ontspannen omgeving wordt gecreëerd waarin voldoende cues aanwezig zijn om activiteit te stimuleren. Daarom zou voor toestandsgeoriënteerde mensen een ondersteunende en directieve leiderschapsstijl het meest effectief zijn. Actiegeoriënteerde mensen presteren juist beter onder druk en op veeleisende taken. Daarom zou voor hen een prestatiegerichte leiderschapsstijl het meest effectief zijn.

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